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NATIONAL DAM INSPECTION PROGRAM. LAUREL HILL CREEK DAM, (NDS I.--ETC(U)
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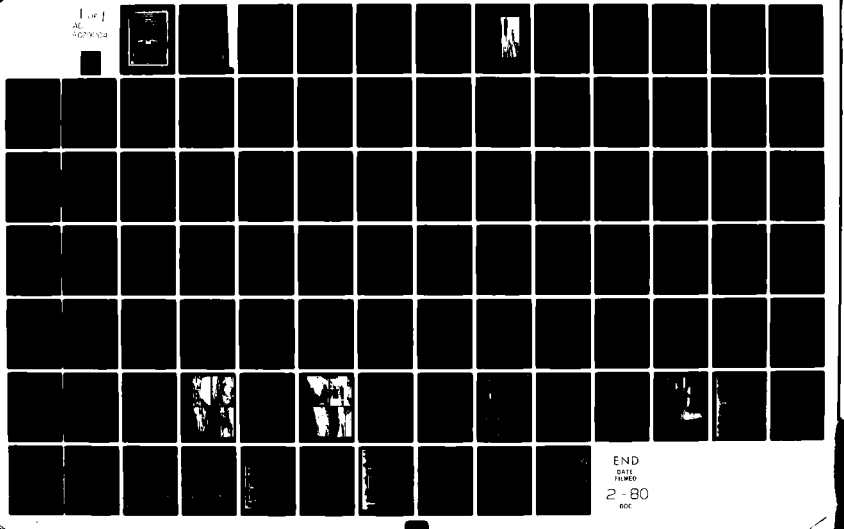

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PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

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DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

PREPARED BY

GAI CONSULTANTS, INC.
570 BEATTY ROAD
MONROEVILLE, PENNSYLVANIA 15146

SEPTEMBER 1979

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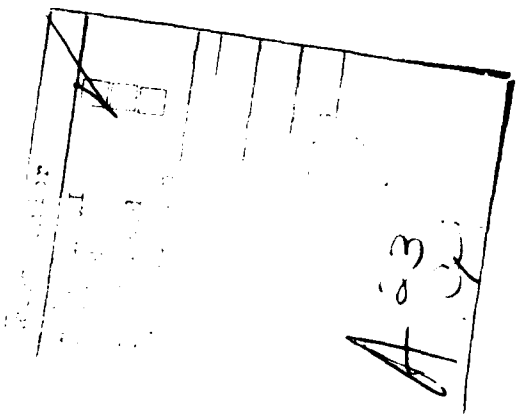
PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D. C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topograhic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition, and the downstream damage potential.



PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM

ABSTRACT

Laurel Hill Creek Dam: NDI I.D. No. PA-00235

Owner:	Municipal Authority of the Borough of Somerset
State Located:	Pennsylvania (PennDER I.D. No. 56-85)
County Located:	Somerset
Stream:	Laurel Hill Creek
Inspection Date:	7 August 1979
Inspection Team:	GAI Consultants, Inc. 570 Beatty Road Monroeville, Pennsylvania 15146

Based on the visual inspection, operational history, and available engineering data, the dam and its appurtenances are considered to be in good condition.

The size classification for the facility is intermediate and the hazard classification is high. In accordance with the recommended guidelines, the Spillway Design Flood (SDF) for the facility is the Probable Maximum Flood (PMF). Results of the hydrologic and hydraulic analysis indicate that the facility is capable of passing and/or storing only 36 percent of the PMF. The analysis also indicates that spillway discharges are controlled by tne downstream valley capacity when the flow over the weir exceeds approximately 3 feet (10 feet below the embankment) after which the pool level and tailwater will rise at roughly the same rate. Thus, failure from overtopping is essentially precluded and the spillway is considered inadequate, but not seriously inadequate.

The consequences of embankment inundation by tailwater and subsequent rapid drawdown are uncertain; although, it is noted that portions of the downstream slope are designated as pervious fill and rock toe on the design drawings. This construction is favorable with respect to rapid drawdown response; however, thorough inspection of the embankment should be performed during and after inundation.

Structural deficiencies noted during the inspection included low spots (≈1 foot low) along the dam crest, lack of pro-

tective vegetation on portions of the downstream dam face, and swamp-like conditions immediately downstream of the dam toe.

It is recommended that the owner:

a. Develop a formal warning system for the notification of downstream residents should hazardous embankment conditions develop. Included in the plan should be provisions for around-the-clock surveillance of the facility during periods of unusually heavy precipitation and for thorough inspection of the downstream slope during tailwater drawdown.

b. Develop formal manuals of maintenance and operation to ensure continued proper care and maintenance of the facility.

c. Backfill low spots along the embankment crest to restore it to its design elevation.

d. Divert or control excess drainage from the left abutment to prevent ponding at the downstream embankment toe.

e. Seed the bare areas on the downstream embankment slope in order to provide adequate erosion protection.

f. Observe the slide immediately upstream of the left abutment during regular inspection of the facility to confirm that it is a local condition and take necessary remedial measures should it threaten the stability of the embankment.

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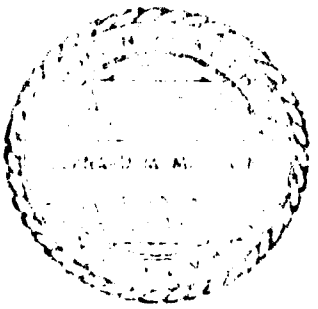

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(6) National Dam Inspection Program, Laurel Hill Creek Dam, (NDS I.D Number PA-00235, Penn der I.D. Number 56-85) Ohio River Basin, Laurel Hill Creek, Somerset County, Pennsylvania, Phase I Inspection Report,

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OVERVIEW PHOTOGRAPH

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LAUREL HILL CREEK DAM
NDI# PA-235, PENNDER# 56-85

SECTION 1
GENERAL INFORMATION

1.0 Authority.

The Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.

1.1 Purpose.

The purpose is to determine if the dam constitutes a hazard to human life or property.

1.2 Description of Project.

a. Dam and Appurtenances. Laurel Hill Creek Dam is a 22-foot high zoned earthfill embankment approximately 575 feet in length. The facility is provided with a 150-foot long concrete spillway, consisting of 15 bays, each containing precast concrete stoplogs (see Photograph 1 and 2).

In addition, the facility is provided with a 16-inch diameter cast iron supply line with the intake located in the right spillway sidewall (see Figure 2). A pumphouse facility located just downstream from the right abutment is used to draw water from the reservoir for treatment and use as potable water.

b. Location. Laurel Hill Creek Dam is located on Laurel Hill Creek, just north of the community of Bakersville, Somerset County, Pennsylvania. The dam, reservoir, and watershed are located on the Bakersville and Seven Springs, Pennsylvania, 7.5 minute U.S.G.S. topographic quadrangles. The coordinates of the dam are N40° 2' 50" and W79° 12' 5".

c. Size Classification. Intermediate (22 feet high, 2113 acre-feet storage capacity at top of dam).

d. Hazard Classification. High (see Section 3.1.e).

e. Ownership. Municipal Authority of the Borough of Somerset
340 West Union Street
Somerset, Pennsylvania 15501

f. Purpose. Water supply.

g. Historical Data. No data are available in PennDER files concerning the structure's history prior to 1978 when modifications were made to the intake system. At that time, the wooden stoplogs were replaced by precast concrete stoplogs, and a portion of the reservoir area was dredged. Conversations with the owner's representatives revealed that the facility was designed by Gannett, Fleming, Corddry and Carpenter, Inc., of Harrisburg, Pennsylvania, and that the facility was completed in 1954. No modifications, aside from those mentioned above, were reportedly made to the structure; although, one or two original drawings included provisions for raising the dam by about 18 feet in the future.

1.3 Pertinent Data.

a. Drainage Area (square miles). 26.2

b. Discharge at Dam Site.

Discharge Capacity of the 16-inch Diameter Supply Line - Not determined.

Discharge Capacity of the Spillway at Maximum Pool = 12,200 cfs (see Appendix C, Sheet 7).

c. Elevation (feet above mean sea level). The following elevations were obtained from available design drawings and through field measurements that were based on the elevation of the spillway crest at 1982.0 feet.

Top of Dam	1995 (design) 1994.1 (field)
Maximum Design Pool	Not known
Maximum Pool of Record	1987 (9-14-71)
Downstream Embankment Toe	1975
Downstream Spillway Toe	1973
Normal Pool	1982
Spillway Crest	1982
Upstream Outlet Invert	1975 (water supply)
Downstream Outlet Invert	N/A
Streambed at Dam Centerline	1975
Maximum Tailwater	1987 (estimated)

d. Reservoir Length (miles).

Top of Dam	2.5
Normal Pool	0.6

e. Storage (acre-feet).

Top of Dam	2113
Normal Pool	250
Design Surcharge	Not known

f. Reservoir Surface (acres).

Top of Dam	284
Normal Pool	24
Maximum Design Pool	Not known

g. Dam.

Type	Zoned earth.
Length	575 feet (including spillway).
Height	22 feet (field measured, crest to downstream spillway toe).
Top Width	10 feet
Upstream Slope	3H:1V
Downstream Slope	2H:1V
Zoning	Impervious core flanked by pervious shells (see Figure 3).
Impervious Core	Impervious fill comprises the center section of the dam (see Figure 3).
Cutoff	The cutoff trench, as indicated in Figure 3, reportedly is extended to sound rock.

	Grout Curtain	None indicated.
h.	Diversion Canal and Regulating Tunnels.	None.
i.	Spillway.	
	Type	Free overfall, concrete stoplog weir structure.
	Crest Elevation	1982 feet
	Crest Length	150 feet
j.	Outlet Works.	
	Supply Pipe	16-inch diameter cast iron pipe with intake located in the right sidewall of the spillway. Water must be pumped from the reservoir.
	Blowoff Pipe	None. Drawdown controlled via stoplogs in spillway.
	Conduit Length	N/A
	Closure and/or Regulating Facilities	Supply line regulated in the pumphouse via gate valves and pump. Reservoir level controlled by stoplogs in spillway.
	Access	Pumphouse is located just downstream from right abutment at an elevation above the embankment crest elevation.

SECTION 2
ENGINEERING DATA

2.1 Design.

a. Design Data Availability and Sources. No design reports or calculations are available from the owner, designer, or PennDER concerning any aspect of the facility. Design drawings are available in PennDER files. Correspondence relating to modifications to the water distribution system (undertaken in 1978) are also available from PennDER files.

b. Design Features.

1. Embankment. Information contained on design drawings indicate that the embankment is a rolled earth structure consisting primarily of a thick impervious core bounded by pervious zones both upstream and downstream. A rock toe was incorporated into the design to provide drainage. The upstream slope is mantled with a 2-foot thick durable rock face and is sloped at 3H:1V, whereas, the downstream slope is set at 2H:1V and grass covered.

Little formal information is available concerning the dam foundation. However, discussions with the designer confirmed that the cutoff was extended to sound rock.

2. Appurtenant Structures.

a) Spillway. The spillway is a free overfall concrete stoplog weir structure located adjacent to the right abutment. The weir crest is 150 feet long and consists of 15 spillway bays containing precast concrete stoplogs. The spillway discharges onto a reinforced concrete slab which extends approximately 13 feet downstream from the weir and into the natural downstream watercourse (see Figure 2).

b) Outlet Works. The outlet works at Laurel Hill Creek Dam consist of a 16-inch diameter cast iron supply line which is controlled from a pumphouse located just downstream of the dam on the right abutment. Discharge is regulated via a system of gates and pumps situated within the pumphouse.

c. Design Data and Procedures.

1. Embankment. No design data or information relative to design procedures are available.

2. Appurtenant Structures. No design data or information relative to design procedures are available.

2.2 Construction Records.

No formal records pertaining to the construction of the facility are available. Verification of cutoff trench construction to sound rock was obtained from discussions with a representative of the designer who was present during construction.

2.3 Operational Records.

No pool level, rainfall, or spillway discharge records are available for the facility; however, two high water levels were recorded with paint marks on the right sidewall of the spillway. The high pool levels were measured at elevation 1986 (corresponding to flood of 8-19-69), and at elevation 1987 (corresponding to flood of 9-14-71).

2.4 Other Investigations.

A survey of the reservoir was conducted in 1974 in order to determine the need for dredging.

2.5 Evaluation.

Specific design calculations and criteria were not available for review; however, information in the form of drawings and correspondence are considered sufficient to make a reasonable Phase I assessment of the facility.

SECTION 3
VISUAL INSPECTION

3.1 Observations.

a. General. The visual inspection of the facility suggested that the dam and its appurtenances are in good condition.

b. Embankment. No seepage through the face of the dam or indications of embankment instability were noted during the field inspection. Some minor deficiencies were observed which will require the owner's attention. These include:

1. Low spots on the embankment crest at the left abutment and at the left sidewall of the spillway.

2. Standing water and swamp-like conditions at the downstream toe of the dam (see Photograph 4).

3. Exposed, unvegetated portions of the downstream dam face (see Photograph 5).

The swamp-like condition at the dam toe (see Photograph 4) extends to an elevation above the normal pool level, and is probably related to a spring in the left abutment. The condition is not considered serious, but should be rectified as it prevents an accurate assessment of the performance of the dam.

c. Appurtenant Structures.

1. Spillway. The visual inspection of the spillway revealed that the structure is in good condition. Wooden stoplogs were replaced by precast concrete stoplogs in 1978. No signs of significant concrete deterioration were observed at the time of inspection (see Photograph 1 and 2).

2. Outlet Works. The intake to the Borough of Somerset water distribution system consists of a 16-inch diameter cast iron pipe located in the right sidewall of the spillway. The intake was submerged at the time of inspection and, consequently, was not observed. Modifications were made to the system in 1978, and it is reported to be operating as designed.

d. Reservoir Area. The reservoir is bounded by moderately to steeply sloping terrain which is equally composed of forested and agricultural lands. A small slide (see Photograph 6) was observed on the left abutment

just upstream from the dam crest. The slide is apparently centered in colluvial soils and was probably activated during construction of an access road which was used for equipment transport at the time of the dredging operation in 1978.

e. Downstream Channel. The downstream channel area is characterized as a mature valley containing the meandering Laurel Hill Creek. Much of the valley bottom is swampland owing to the frequent flooding and gentle stream gradient. Approximately one mile downstream from the dam, Laurel Hill Creek passes beneath PA Route 31. Just north of this point are a few homes and businesses in the community of Bakersville which are located on the floodplain, and are quite possibly located within the area which could be affected by a dam failure. In addition, there are a few low-lying homes in the community of Jimtown (approximately two miles downstream from the dam) which are in a similar situation. The Laurel Hill Lake Dam at Laurel Hill State Park (owned by PennDER) is located about 5.5 miles downstream from the Laurel Hill Creek Dam (see Photograph 8). Therefore, the Laurel Hill Creek facility is considered to be a high hazard.

3.2 Evaluation.

The overall condition of the facility is considered to be good. Minor deficiencies including low spots on the crest, ponded water at the downstream embankment toe, and lack of protective vegetation on portions of the downstream embankment slope require remedial work, while the slide upstream of the left abutment should be observed periodically to confirm that it is a localized condition.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Normal Operating Procedure.

Under normal operating conditions, water is pumped from the reservoir on an as-needed basis to be treated and used as a potable water supply for the Borough of Somerset. Excess inflow is discharged over the stoplogged weir structure.

4.2 Maintenance of the Dam.

No formal maintenance program exists at the facility. Normal maintenance consists primarily of clearing the dam slopes on an unscheduled basis.

4.3 Maintenance of Operating Facilities.

The valves controlling discharge of water from the reservoir are located in a pumphouse situated downstream on the right abutment. The only maintenance required at the dam site consists of periodically raising and cleaning the trash rack which protects the inlet to the 16-inch diameter cast iron supply pipe.

4.4 Warning System.

No formal warning system is in effect at the facility.

4.5 Evaluation.

No formal operations or maintenance manuals are available and no warning system exists for the facility. Formal manuals are recommended to ensure continued maintenance and to provide notification of downstream residents should an emergency develop.

SECTION 5
HYDROLOGIC/HYDRAULIC EVALUATION

5.1 Design Data.

No design data, calculations, or reports are available. Available data are limited to design drawings and correspondence contained in PennDER files.

5.2 Experience Data.

Daily records of reservoir levels and/or spillway discharges are not availale; however, two high water marks were recorded on the right spillway sidewall. The lower mark was measured at about elevation 1986 feet (or about 4 feet above the spillway crest), and corresponded to the flood of 8-19-69. The higher mark was measured at about elevation 1987 feet (or about 5 feet above the spillway crest), and corresponded to the flood of 9-14-71. Photographs indicating high tailwater under small discharges are available from the owner's files.

5.3 Visual Observations.

On the date of inspection, no conditions were observed that would indicate the spillway could not perform adequately during a flood event within the limits of its design.

5.4 Method of Analysis.

The facility has been analyzed in accordance with the procedures and guidelines established by the U. S. Army, Corps of Engineers, Baltimore District, for Phase I hydrologic and hydraulic evaluations. The analysis has been performed utilizing a modified version of the HEC-1 program developed by the U. S. Army, Corps of Engineers, Hydrologic Engineering Center, Davis, California. Analytical capabilities of the program are briefly outlined in the preface contained in Appendix C.

5.5 Summary of Analysis.

a. Spillway Design Flood (SDF). In accordance with the procedures and guidelines contained in the National Guidelines for Safety Inspection of Dams for Phase I Investigations, the Spillway Design Flood (SDF) for Laurel Hill Creek Dam is the Probable Maximum Flood (PMF). That

is, based on its relative size (intermediate) and hazard potential (high), the facility is required to have sufficient spillway and storage capabilities to safely discharge the PMF without overtopping the embankment.

b. Results of Analysis. Laurel Hill Creek Dam was evaluated under normal operating conditions. That is, the reservoir was initially at its normal pool or spillway elevation of 1982 feet, with the spillway discharging freely. The spillway is a free overfall, concrete, stoplog weir structure. Since the weir crest elevation is not very high relative to the outlet channel invert elevation, and since the channel gradient downstream from the dam is very gentle, a tailwater rating curve was computed. All pertinent engineering calculations relative to the evaluation of this facility are provided in Appendix C.

Overtopping analysis (using the Modified HEC-1 Computer Program) indicated that the discharge/storage capacity of Laurel Hill Creek Dam can accommodate only about 36 percent of the PMF (SDF) prior to the overtopping of the embankment (Appendix C, Summary Input/Output Sheets, Sheet K). Under the PMF, the embankment will be overtopped for approximately 12.3 hours with a maximum depth of inundation equal to about 10.5 feet above the low top of dam elevation of 1994.1 feet (Summary Input/Output Sheets, Sheet K).

Actually, the spillway weir does not control reservoir outflows once the reservoir level rises roughly above elevation 1985 feet (or ≈3 feet above the spillway crest). The downstream channel and valley are on such a gentle slope (≈0.1 percent as measured on the U.S.G.S. 7.5 minute topographic quadrangle, Bakersville, Pennsylvania) that the capacities of the downstream valley sections control spillway discharges (Appendix C, Sheets 8 and 9). Therefore, above elevation 1985 feet, the reservoir and tailwater levels should rise at about the same rate.

5.6 Spillway Adequacy.

Although Laurel Hill Creek Dam can accommodate only about 36 percent of its SDF (the PMF), breaching of the embankment due to overtopping by large floods is unlikely due to the probable high tailwater conditions on the dam. Thus, the spillway system is considered inadequate, but not seriously inadequate since overtopping cannot increase the potential for loss of life downstream of the facility.

SECTION 6
EVALUATION OF STRUCTURAL INTEGRITY

6.1 Visual Observations.

a. Embankment. Based on visual observations, the embankment appeared to be in good condition. A few minor deficiencies were noted at the time of inspection which will require the owner's attention. They are:

1. The embankment is approximately 1 foot below design elevation just to the left of the spillway and at the left abutment.

2. Swamp-like conditions exist at the downstream dam toe which preclude an accurate evaluation of the dam's performance (particularly under high pool levels).

3. A portion of the downstream face is not adequately protected against erosion.

In addition to the above stated deficiencies, a slide was observed on the left abutment just upstream from the dam crest. The slide, in its present configuration and extent, is not considered deleterious to the integrity of the dam; however, the slide should be observed regularly and provisions made to remedy the problem if the need arises.

b. Appurtenant Structures.

1. Spillway. The spillway was modified in 1978 when concrete stoplogs were substituted for the original wooden stoplogs. Since the spillway was discharging at the time of inspection, it was not possible to observe the spillway foundation or condition of the stoplogs. However, those portions of the spillway which were visible appeared to be in good condition.

2. Outlet Works. The outlet works (supply system) was modified in 1978 to better serve the needs of the Municipal Authority. The system was not observed by the field team, but, reportedly is functioning as designed.

6.2 Design and Construction Techniques.

No design or construction records are available with the exception of a set of construction drawings contained in PennDER files. Discussions with a representative of the designer indicated the cutoff trench was extended to rock.

6.3 Past Performance.

According to Municipal Authority personnel, the facility has functioned as designed since construction. Two high water levels are recorded on the right spillway sidewall, and are dated 8-19-69 and 9-14-71. The elevations of these water marks were measured at approximately 4 and 5 feet above the spillway crest, respectively.

6.4 Seismic Stability.

The dam is located in Seismic Zone No. 1, and is thus subject to minor earthquake induced dynamic forces. As the overall stability of the embankment appears adequate, and the dam is constructed of compacted soils; it is thought that the facility can withstand minor earthquake induced dynamic forces. No calculations and/or investigations were performed to confirm this opinion.

SECTION 7
ASSESSMENT AND RECOMMENDATIONS FOR REMEDIAL MEASURES

7.1 Dam Assessment.

a. Safety. Visual observations indicate that Laurel Hill Creek Dam is in good condition. Hydrologic and hydraulic calculations performed during the investigation indicate that the facility will pass and/or store only 36 percent of the PMF prior to overtopping of the embankment. However, downstream conditions are such that even very low spillway discharges (3 feet over the weir) produce tailwater conditions which essentially preclude the possibility of failure due to embankment overtopping. That is, at low heads the spillway outflows are controlled by the downstream channel and valley capacities. Thus, there will be a rise in reservoir and tailwater pool levels, at roughly the same rate, which will gradually submerge the embankment.

Therefore, although the facility is capable of passing and/or storing only 36 percent of the PMF, overtopping will not lead to embankment failure and a significant increase to the downstream potential for loss of life or damage. Consequently, the spillway is considered inadequate, but not seriously inadequate.

The consequences of embankment inundation by tailwater and subsequent rapid drawdown are uncertain although it is noted that portions of the downstream slope are designated as pervious fill and rock toe on the design drawings. This construction is favorable with respect to rapid drawdown response; however, thorough inspection of the embankment should be performed during and after inundation.

Structural deficiencies noted during the field inspection included low spots (≈1 foot low) on the dam crest at the junctions of the embankment-left abutment and embankment left spillway sidewall. In addition, part of the downstream dam face is void of protective vegetation and is subject to erosion. Finally, a spring which discharges from the left abutment, flows along the downstream dam toe and has supported lush vegetation which could preclude an accurate evaluation of the performance of the dam (particularly under raised pool levels).

b. Adequacy of Information. The available information is considered adequate to make a reasonable Phase I assessment of the facility.

c. Urgency. The recommendations listed below should be implemented as soon as possible.

d. Necessity for Additional Investigations. No additional investigations are considered necessary at this time. Provisions for increasing the embankment height by 18 feet are presented on the design drawings. Should the owner consider implementing the modification, a detailed hydraulic and hydrologic study is recommended with tailwater effects considered.

7.2 Recommendations/Remedial Measures.

It is recommended that the owner immediately:

a. Develop a formal warning system for the notification of downstream residents should hazardous embankment conditions develop. Included in the plan should be provisions for around-the-clock surveillance of the facility during periods of unusually heavy precipitation and for thorough inspection of the downstream slope during tailwater drawdown.

b. Develop formal manuals of maintenance and operation to ensure continued proper care and maintenance of the facility.

c. Backfill low spots along the embankment crest to restore it to its design elevation.

d. Divert or control excess drainage from the left abutment to prevent ponding at the downstream embankment toe.

e. Seed the bare areas on the downstream embankment slope in order to provide adequate erosion protection.

f. Observe the slide immediately upstream of the left abutment during regular inspection of the facility to confirm that it is a local condition and take necessary remedial measures should it threaten the stability of the embankment.

APPENDIX A

CHECK LIST - ENGINEERING DATA

NAME OF DAM: Laurel Hill Creek Dam

NDI#: PA-235 PENNDER#: 56-85

CHECK LIST
ENGINEERING DATA
PHASE I

ITEM	REMARKS NDI# PA - 235
PERSONS INTERVIEWED AND TITLE	Mr. J. Kane - Manager (Somerset Borough); Secretary (Somerset Water Authority) Mr. Eric Critchfield - The Neilan Engineers, Inc., Somerset, Pennsylvania Mr. A. C. Hooke (Head, Dam Section) - Gannett, Fleming, Corddry, and Carpenter, Inc., (via phone)
REGIONAL VICINITY MAP	See Appendix G (U.S.G.S. 7.5 minute topographic quadrangle, Bakersville, Pennsylvania).
CONSTRUCTION HISTORY	Designed by Gannett, Fleming, Corddry, and Carpenter. Constructed by Roberts and Schaefer Company, and completed in 1954. No correspondence other than drawings, relative to the original construction are available in PennDER files (see Section 1.2.g).
AVAILABLE DRAWINGS	Set of 13 design drawings available in PennDER files. Representative drawings are provided in Appendix F.
TYPICAL DAM SECTIONS	See Appendix F, Figure 3.
OUTLETS: PLAN DETAILS DISCHARGE RATINGS	See Appendix F, Figures 2, 4, 5, and 6. Not available.

ITEM	REMARKS NDI# PA - 235
SPILLWAY: PLAN SECTION DETAILS	See Appendix F, Figures 2, 3, 4, 5, and 6.
OPERATING EQUIPMENT PLANS AND DETAILS	See Appendix F, Figures 2, 4, 5, and 6.
DESIGN REPORTS	None available.
GEOLOGY REPORTS	None available.
DESIGN COMPUTATIONS: HYDROLOGY AND HYDRAULICS STABILITY ANALYSES SEEPAGE ANALYSES	None available.
MATERIAL INVESTIGATIONS: BORING RECORDS LABORATORY TESTING FIELD TESTING	Boring records shown on Figure 3, Appendix F Laboratory and/or field test data are not available.

ITEM	REMARKS NDI# PA - 235
BORROW SOURCES	Not known.
POST CONSTRUCTION DAM SURVEYS	Dredging survey in 1973-1974.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	Water system improvement study in 1978. Report not available.
HIGH POOL RECORDS	High pool levels noted on right sidewall of spillway dated 8-19-69 and 9-14-71. Water levels corresponding to these dates are 4 and 5 feet, respectively, above the spillway crest.
MONITORING SYSTEMS	None.
MODIFICATIONS	Drainage ditch constructed in spring 1979 to convey left abutment spring away from toe of dam.

ENGINEERING DATA (CONTINUED)

NDI# PA - 235

ITEM	REMARKS
PRIOR ACCIDENTS OR FAILURES	None.
MAINTENANCE: RECORDS MANUAL	None available.
OPERATION: RECORDS MANUAL	None available.
OPERATIONAL PROCEDURES	Water is pumped as needed from reservoir, is treated, and is used as a possible water source for the Borough of Somerset.
WARNING SYSTEM AND/OR COMMUNICATION FACILITIES	No formal warning system. However, the treatment facility is located adjacent to the dam and is manned at least 8 hours per day.
MISCELLANEOUS	Rain gage located near dam site. According to the owner's representatives, the spillway weir is drowned out at low flows (pictures available in owner's files).

CHECK LIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

NDI ID # PA-235
PENN DER ID # 56-85

SIZE OF DRAINAGE AREA: 26.2 square miles

ELEVATION TOP NORMAL POOL: 1982.0 STORAGE CAPACITY: 250 acre-feet

ELEVATION TOP FLOOD CONTROL POOL: -- STORAGE CAPACITY: --

ELEVATION MAXIMUM DESIGN POOL: -- STORAGE CAPACITY: --

ELEVATION TOP DAM: 1994.1 STORAGE CAPACITY: 2113 acre-feet

SPILLWAY DATA

CREST ELEVATION: 1982.0 feet

TYPE: Free overfall, concrete, stoplog weir structure

CREST LENGTH: 150 feet (15 bays at 10 feet each)

CHANNEL LENGTH: N/A

SPILLOVER LOCATION: Near right abutment

NUMBER AND TYPE OF GATES: None

OUTLET WORKS

TYPE: 16-inch diameter C.I.P. supply line

LOCATION: Right sidewall of spillway

ENTRANCE INVERTS: 1975

EXIT INVERTS: N/A

EMERGENCY DRAWDOWN FACILITIES: Stoplogs in spillway weir

HYDROMETEOROLOGICAL GAGES

TYPE: Raingage

LOCATION: Near treatment facility

RECORDS: Daily records available.

MAXIMUM NON-DAMAGING DISCHARGE: Reportedly the discharge corresponding to a height of about 5 feet above the spillway which occurred 9-14-71.

APPENDIX B

CHECK LIST - VISUAL INSPECTION

CHECK LIST
VISUAL INSPECTION
PHASE 1

NAME OF DAM Laurel Hill Creek Dam STATE Pennsylvania COUNTY Somerset

NDI# PA - 235 PENNDER# 56-85

TYPE OF DAM Zoned earth SIZE Intermediate HAZARD CATAGORY High

DATE(S) INSPECTION 7 August 1979 WEATHER Clear and Hot TEMPERATURE 85° @ 1:00 p.m.

POOL ELEVATION AT TIME OF INSPECTION 1982 M.S.L.

TAILWATER AT TIME OF INSPECTION 1976 M.S.L.

INSPECTION PERSONNEL	OWNER REPRESENTATIVES	OTHERS
J. P. Nairn	Mr. J. Kane - Manager, Borough	
W. J. Veon	of Somerset Municipal Authority	
D. L. Bonk	Mr. Eric Critchfield - Neilan	
	Engineers	

RECORDED BY D. L. Bonk

ITEM	OBSERVATIONS AND/OR REMARKS NDI# PA - 235
SURFACE CRACKS	None observed.
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed.
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Evidence of sliding observed along left abutment approximately 50 feet upstream of the embankment crest.
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Horizontal - Good Vertical - Settlements of approximately 1-foot measured along the embankment crest.
RIPRAP FAILURES	None observed. Upstream embankment face is covered to the crest with a layer of dumped sandstone riprap.
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Good. Minor settlement noted at junctions of embankment and left abutment and embankment and left sidewall of spillway.

EMBANKMENT

ITEM	OBSERVATIONS AND/OR REMARKS NDI# PA - 235
DAMP AREAS IRREGULAR VEGETATION (LUSH OR DEAD PLANTS)	Damp area. Located across entire downstream embankment toe between spillway and left abutment, apparently the result of a spring that drains down the left abutment hillside.
ANY NOTICEABLE SEEPAGE	None through embankment. All wet areas observed at the downstream embankment toe were measured to originate at elevations above normal pool. Thus, all of the observed wet areas are considered to be a result of that water draining from the left abutment.
STAFF GAGE AND RECORDER	None observed. High pool marks are painted along right wingwall of spillway, upstream of the weir, and are dated 8-19-69 and 9-14-71. Water levels corresponding to these dates were measured at 4 and 5 feet, respectively, above normal pool.
DRAINS	None observed. Contract drawings indicate rock toe.

OUTLET WORKS

ITEM	OBSERVATIONS AND/OR REMARKS NDI# PA - 235
INTAKE STRUCTURE	Two intakes are located on the inside face of the right wingwall of the spillway. The lower intake was submerged below normal pool and not observed. The upper intake is protected by a trash rack, and was reportedly constructed as a contingency for the eventual raising of the embankment.
OUTLET CONDUIT (CRACKING AND SPALLING OF CONCRETE SURFACES)	N/A
OUTLET STRUCTURE	N/A
OUTLET CHANNEL	See "Discharge Channel" Page 5 of 8.
GATE(S) AND OPERATIONAL EQUIPMENT	Contained within a pumphouse located on the right abutment.

ITEM	OBSERVATIONS AND/OR REMARKS NDI# PA - 235
TYPE AND CONDITION	Free overfall, concrete, stoplog weir structure.
APPROACH CHANNEL	See Appendix F, Figure 4. Submerged, not observed.
SPILLWAY CHANNEL AND SIDEWALLS	Good condition.
STILLING BASIN PLUNGE POOL	See Appendix F, Figure 4. Submerged, not observed.
DISCHARGE CHANNEL	Spillway discharges into the natural Laurel Hill Creek channel which is on a very gentle gradient.
BRIDGE AND PIERS	None.
EMERGENCY GATES	15 spillway bays equipped with removable concrete stoplogs.

ITEM	OBSERVATIONS AND/OR REMARKS NDI# PA - 235
TYPE AND CONDITION	N/A
APPROACH CHANNEL	N/A
OUTLET STRUCTURE	N/A
DISCHARGE CHANNEL	N/A

ITEM	OBSERVATIONS AND/OR REMARKS NDI# PA - 235
MONUMENTATION SURVEYS	None.
OBSERVATION WELLS	None.
WEIRS	None.
PIEZOMETERS	None.
OTHERS	

ITEM	OBSERVATIONS AND/OR REMARKS NDI# PA - 235
SLOPES: RESERVOIR	Moderate to steep and equally divided between agricultural and forested areas.
SEDIMENTATION	Quite a problem at this facility. Portions of reservoir dredged in 1978. Problem reportedly worsened when new portions of Pennsylvania Turnpike were constructed.
DOWNSTREAM CHANNEL (OBSTRUCTIONS, DEBRIS, ETC.)	Pennsylvania Route 31 Bridge is located approximately 1 mile downstream from the dam. Another bridge is located about 2 miles downstream, and the Laurel Hill Lake Dam at Laurel Hill State Park is located about 5.5 miles downstream from the dam.
SLOPES: CHANNEL VALLEY	The channel slope is very gentle (on the order of 0.1 percent) for the entire 5.5 mile distance to the Laurel Hill Lake Dam. The stream valley is broad in sections, with moderate to steep side slopes.
APPROXIMATE NUMBER OF HOMES AND POPULATION	Several residences and businesses are located in the Laurel Hill Creek floodplain at 1 and 2 miles downstream from the dam (estimated population ≈15 to 20). The structures are low enough such that they could be affected by the outflow produced by failure of the dam. In addition, the Laurel Hill Lake Dam is located 5.5 miles downstream and failure of the Laurel Hill Creek facility could possibly cause the Laurel Hill Lake facility to fail.

APPENDIX C

HYDROLOGY AND HYDRAULICS

PREFACE

The modified HEC-1 program is capable of performing two basic types of hydrologic analyses: (1) the evaluation of the overtopping potential of the dam; and (2) the estimation of the downstream hydrologic-hydraulic consequences resulting from assumed structural failures of the dam. Briefly, the computational procedures typically used in the dam overtopping analysis are as follows:

a. Development of an inflow hydrograph(s) to the reservoir.

b. Routing of the inflow hydrograph(s) through the reservoir to determine if the event(s) analyzed would overtop the dam.

c. Routing of the outflow hydrograph(s) from the reservoir to desired downstream locations. The results provide the peak discharge(s), time(s) of the peak discharge(s), and the maximum stage(s) of each routed hydrograph at the downstream end of each reach.

The evaluation of the hydrologic-hydraulic consequences resulting from an assumed structural failure (breach) of the dam is typically performed as outlined below.

a. Development of an inflow hydrograph(s) to the reservoir.

b. Routing of the inflow hydrograph(s) through the reservoir.

c. Development of a failure hydrograph(s) based on specific breach criteria and normal reservoir outflow.

d. Routing of the failure hydrograph(s) to desired downstream locations. The results provide estimates of the peak discharge(s), time(s) to peak, and maximum water surface elevation(s) of the failure hydrograph(s) for each location.

SUBJECT DAM SAFETY INSPECTION
LAUREL HILL CREEK DAM

BY WJV DATE 8/13/79 PROJ. NO. 79-617-235

CHKD. BY DJS DATE 9-14-79 SHEET NO. 1 OF 15

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DAM STATISTICS

HEIGHT OF DAM ≈ 22 FT (FIELD MEASURED)
(MEASURED FROM STREAM CHANNEL
@ DOWNSTREAM SPILLWAY TOE
TO TOP OF EMBANKMENT)

MAXIMUM POOL STORAGE CAPACITY ≈ 2113 AC-FT (SEE SHEET 4)
@ LOW TOP OF DAM

NORMAL POOL STORAGE CAPACITY ≈ 250 AC-FT (SEE NOTE 1)

DRAINAGE AREA ≈ 26.2 SQ MI

[PLANIMETERED OFF USGS 7.5 MINUTE QUADS: SEVEN SPRINGS AND BALERSVILLE, PA

NOTE 1: STORAGE CAPACITY OBTAINED FROM "DAMS, RESERVOIRS AND NATURAL LAKES", WATER RESOURCES BULLETIN NO. 5, COMMONWEALTH OF PENNSYLVANIA, DEPARTMENT OF FORESTS AND WATER, HARRISBURG, PA. THE ACTUAL REPORTED VALUE WAS 90 MILLION GALLONS. HOWEVER, FOLLOWING FIELD INSPECTION IT IS FELT THAT THE EXISTING NORMAL POOL STORAGE IS MUCH LESS.

DAM CLASSIFICATION

DAM SIZE - INTERMEDIATE (REF 1, TABLE 1)

HAZARD CLASSIFICATION - HIGH (FIELD OBSERVATION)

REQUIRED SDF - PMF (REF 1 TABLE 3)

SUBJECT DAM SAFETY INSPECTION
LAUREL HILL RUN DAM

BY WJV DATE 8/13/79 PROJ. NO. 78-617-235

CHKD. BY DJJ DATE 9-14-79 SHEET NO. 2 OF 15

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HYDROGRAPH PARAMETERS

LENGTH OF LONGEST WATERCOURSE ≈ 8.9 MI.

L_{CA} ≈ 2.0 MI (MEASURED ALONG THE LONGEST WATERCOURSE FROM THE DAM TO THE CENTROID OF THE BASIN)

NOTE 2: VALUES OF L AND L_{CA} ARE MEASURED FROM THE USGS 7.5 MINUTE BAKERSVILLE, PA QUAD. ALL VARIABLES ARE DEFINED IN REF 2, IN THE SECTION ENTITLED "SNYDER SYNTHETIC UNIT HYDROGRAPH"

C_t ≈ 1.0
C_p ≈ 0.40

[SUPPLIED BY COE; ZONE 25 OHIO RIVER BASIN]

t_p = SNYDER'S STANDARD LAG ≈ $1.0 (L * L_{CA})^{0.3}$

$\therefore t_p \approx 1.0 (8.9 * 2.0)^{0.3} \approx 2.37$ HRS

RESERVOIR SURFACE AREAS

SURFACE AREA (SA) @ NORMAL POOL EL 1982 ≈ 24 AC

NOTE 3: NORMAL POOL ELEVATION OBTAINED FROM APPENDIX F FIG 3. NORMAL POOL SA OBTAINED FROM THE REFERENCE IN NOTE 1, SHEET 1.

SA @ EL 2000 ≈ 411 AC
SA @ EL 2020 ≈ 942 AC

[PLANIMETERED OFF 7.5 MINUTE USGS BAKERSVILLE, PA QUAD]

ELEVATION LOW TOP OF DAM ≈ 1994.1 FT (FIELD MEASURED)

SUBJECT DAM SAFETY INSPECTION
LAUREL HILL CREEK DAM

BY WJV DATE 8-14-79 PROJ. NO. 78-617-235

CHKD. BY DJS DATE 9-14-79 SHEET NO. 3 OF 15

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RATE OF RESERVOIR SA INCREASE PER FOOT OF RESERVOIR RISE : $\Delta SA/\Delta H \approx (411 - 24)\,AC/(2000 - 1982)\,FT \approx 21.5\ \frac{A}{F}$

$\therefore$ SA @ EL 1994.1 $\approx$ 24 AC + [(21.5 AC/FT) × (1994.1 − 1982) FT]
$\approx$ 284 AC

RESERVOIR ELEVATION @ "0" STORAGE

APPARENT MINIMUM RESERVOIR ELEVATION ≈ 1973.5 FT
(≈ SPILLWAY FOREBAY ELEVATION AS MEASURED IN THE FIELD)

$\therefore$ SA @ EL 1973.5 ≈ 0 AC

RESERVOIR ELEVATION - STORAGE RELATIONSHIP

- ASSUME THAT STORAGE VARIES LINEARLY BETWEEN THE MINIMUM RESERVOIR ELEVATION VALUE OF 0 AC-FT AND THE REPORTED DESIGN NORMAL POOL VALUE OF 250 AC-FT, FOR SIMPLICITY.

- FOR RESERVOIR ELEVATIONS ABOVE NORMAL POOL EL 1982, ASSUME THAT THE MODIFIED PRISMOIDAL RELATIONSHIP IS REPRESENTATIVE OF THE ACTUAL STORAGE VARIATION. THE RELATIONSHIP IS DEFINED BY:

$$\Delta V_{1\to 2} = \frac{h}{3}\left(A_1 + A_2 + \sqrt{A_1 \times A_2}\right)$$ (REF: 4 PG.

WHERE $\Delta V_{1\to 2}$ = INCREMENTAL VOLUME INCREASE BETWEEN ELEVATIONS 1 AND 2, IN AC-FT;
h = ELEVATION 2 - ELEVATION 1, IN FT;

SUBJECT DAM SAFETY INSPECTION
LAUREL HILL CREEK DAM

BY WJV DATE 9-14-79 PROJ. NO. 78-617-235

CHKD. BY JJS DATE 9-14-79 SHEET NO. 4 OF 15

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A_1 = SA @ ELEVATION 1, IN AC; AND
A_2 = SA @ ELEVATION 2, IN AC.

SA @ ANY ELEVATION CAN BE DEFINED BY

$$A_i = A_o + \left[\left(\Delta SA/\Delta H\right) \times \left(\text{ELEVATION}_i - \text{ELEVATION}_o\right)\right]$$

WHERE A_i = SA @ ELEVATION i, IN AC;
A_o = SA @ NORMAL POOL ≈ 24 AC;
$\Delta SA/\Delta H$ = RATE OF SA INCREASE ≈ 21.5 AC/FT (BELOW EL 2000);
ELEVATION_o = NORMAL POOL EL 1932.0 (BELOW EL 2000); AND
ELEVATION_i = ELEVATION IN QUESTION, IN FT.

- ELEVATION - STORAGE COMPUTATIONS

RESERVOIR ELEVATION (FT)	A_i (AC)	ΔV_{1-2} (AC-FT)	TOTAL VOLUME (AC-FT)
1973.5	0	0	0
* 1982.0	24	250	250
1983.0	46	34	284
1984.0	67	56	340
1985.0	89	78	418
1986.0	110	99	517
1987.0	132	121	638
1988.0	153	142	780
1989.0	175	164	944
1990.0	196	185	1129
1991.0	218	207	1336
1992.0	239	228	1564
1993.0	261	250	1814
1994.0	282	271	2085
** 1994.1	284	28	2113
1995.0	304	265	2378
1996.0	325	314	2692
1997.0	347	336	3028
1998.0	368	357	3385
1999.0	390	379	3764
2000.0	411	400	4164
2005.0	*** 544	2390	6554
2010.0	*** 677	3046	9599

* NORMAL POOL OR SPILLWAY ELEVATION
** LOW TOP OF DAM ELEVATION
*** ABOVE EL 2000 ⇒ A_o ≈ 411 AC; $\Delta SA/\Delta H$ ≈ $(544-411)\text{AC}/(2005-2000)\text{FT}$ ≈ 26 AC/FT

SUBJECT DAM SAFETY INSPECTION
LAUREL HILL CREEK DAM

BY WJV DATE 9-14-79 PROJ. NO. 79-617-235

CHKD. BY DTS DATE 9-14-79 SHEET NO. 5 OF 15

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PMP CALCULATIONS

- APPROXIMATE RAINFALL INDEX = 24 IN (REF 3, FIG 1)
  (CORRESPONDING TO A DURATION OF 24 HOURS AND AN AREA OF 200 SQ MI IN SOUTHWESTERN PENNSYLVANIA)

- DEPTH - AREA - DURATION ZONE #7 (REF 3, FIG 1)

- DRAINAGE AREA ≈ 26.2 SQ MI ⇒ DEPTH - DURATION RELATIONSHIP IS GIVEN AS:

DURATION (HR)	PERCENT OF INDEX RAINFALL (%)
6	92
12	110
24	120
48	130

(REF 3, FIG 2)

- HOP BROOK FACTOR (ADJUSTMENT FOR BASIN SHAPE AS WELL AS FOR THE LESSER LIKELIHOOD OF A SEVERE STORM CENTERING OVER A SMALLER BASIN) CORRESPONDING TO A DA ≈ 26.2 SQ MI ⇒ 0.831 (AS COMPUTED BY HEC-1,

SUBJECT DAM SAFETY INSPECTION
LAUREL HILL CREEK DAM

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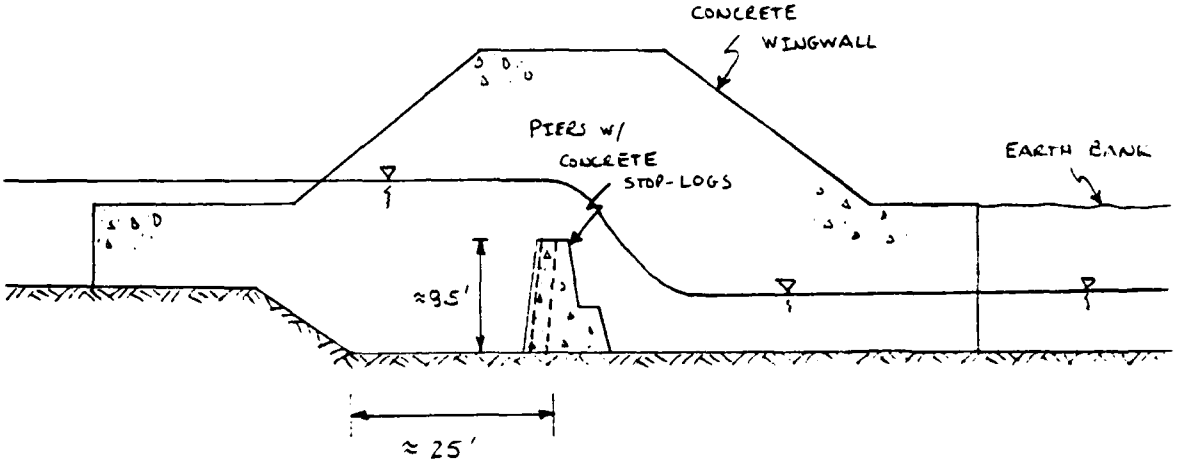
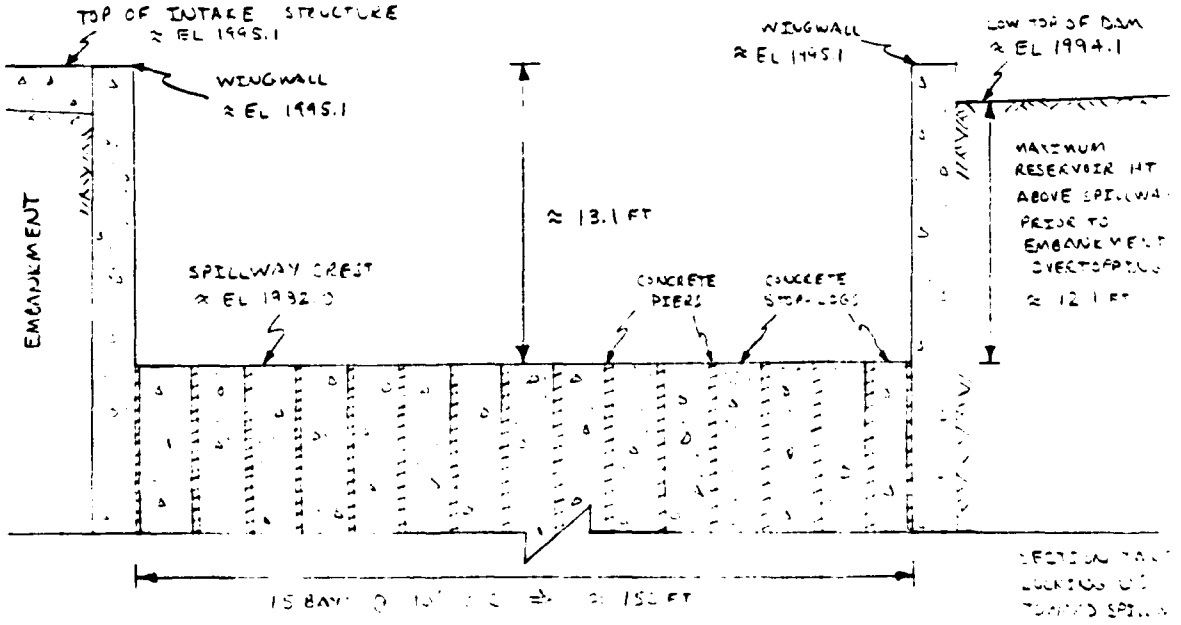
SPILLWAY CAPACITY

- PROFILE OF SPILLWAY : (NOT TO SCALE)
(FROM FIELD MEASUREMENTS AND OBSERVATIONS, AND DESIGN DRAWINGS IN APPEN. F)



- CROSS-SECTION OF SPILLWAY : (NOT TO SCALE)



SUBJECT DAM SAFETY INSPECTION
LAUREL HILL CREEK DAM

BY WJV DATE 9-14-79 PROJ. NO. 78-617-235

CHKD. BY DJS DATE 9-14-79 SHEET NO. 7 OF 15

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- THE SPILLWAY IS A FREE OVERFALL, CONCRETE, STOPLOG WEIR STRUCTURE. THE WEIR CONSISTS OF 15 BAYS OF 10-FT CENTER TO CENTER LENGTH EACH, SUPPORTED BY CONCRETE PIERS. THE TOP OF PIER IS ESSENTIALLY FLUSH WITH THE TOP OF THE STOP-LOGS. THE BREADTH OF THE WEIR CREST IS ABOUT 1 FT. SINCE THE WEIR CREST IS SO SMALL, IT WILL BE ASSUMED THAT THE WEIR IS APPROXIMATELY SHARP-CRESTED. THE DISCHARGE OVER THE WEIR CAN BE ESTIMATED BY:

$$Q = CLH^{3/2} \qquad \text{(REF 5, PG 5-3)}$$

WHERE Q = DISCHARGE IN CFS;
L = LENGTH OF WEIR CREST ≈ 150 FT
H = HEIGHT OF RESERVOIR ABOVE SPILLWAY CREST ELEVATION OF 1932.0 ⇒ MAXIMUM HEAD (H) ≈ 12.1 FT
C = DISCHARGE COEFFICIENT ≈ 3.33 (FOR SHARP-CRESTED WEIRS; REF 5, PG 5-7)

- SPILLWAY CAPACITY (NEGLECTING ANY APPROACH LOSSES):

$$Q \approx (3.33)(150\text{ FT})(12.1\text{ FT})^{3/2} \approx 21{,}020\text{ CFS}$$

HOWEVER, FOR A FLOW OF 21,020 CFS, THE TAILWATER IN THE DAM WOULD REACH TO ABOUT EL 1999.4 FT. SINCE THE LOW TOP OF DAM ELEVATION IS ONLY 1994.1 FT, THE SPILLWAY CAPACITY IS SOMEWHAT LESS THAN 21,020 CFS, AND IS ACTUALLY CONTROLLED BY THE CAPACITY OF THE DOWNSTREAM CHANNEL VALLEY RATHER THAN BY THE SPILLWAY WEIR (SHEET 9). THEREFORE, THE MAXIMUM FLOW THROUGH THE SPILLWAY @ RESERVOIR ELEVATION 1994.1 FT ≈ 12,250 CFS (FROM SHEET 11).

SUBJECT DAM SAFETY INSPECTION
LAUREL HILL CREEK DAM

BY WJV DATE 8-20-79 PROJ. NO. 79-617-235

CHKD. BY DJS DATE 9-14-79 SHEET NO. 9 OF 15

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SPILLWAY RATING CURVE

SPILLWAY DISCHARGES CAN BE ESTIMATED BY THE EQUATION ON SHEET 7 UNTIL THE TAILWATER ELEVATION CORRESPONDING TO A CERTAIN FLOW IS HIGHER THAN THE RESERVOIR LEVEL NECESSARY TO CAUSE THAT FLOW OVER THE WEIR. ASSUME THAT THE ORIGINAL SPILLWAY DESIGN HEAD ≈ 12.1 FT (⇒ MEASURE LOW TOP OF DAM TO SPILLWAY CREST, FOR SIMPLICITY), AND THAT APPROACH CHANNEL LOSSES ARE NEGLIGIBLE. FURTHER, ASSUME THAT THE ACTUAL DISCHARGE COEFFICIENT (C) CORRECTIONS FOR HEADS OTHER THAN DESIGN, AND FOR SUBMERGENCE CAN BE REPRESENTED BY THE CORRECTION RELATIONSHIPS CORRESPONDING TO AN OGEE-SHAPED WEIR.

THE SPILLWAY RATING TABLE IS GIVEN ON SHEET 9.

EMBANKMENT RATING CURVE

DUE TO THE HIGH TAILWATER ON THE DAM, THE DOWNSTREAM CHANNEL VALLEY CAPACITY WILL CONTROL EMBANKMENT OVERFLOWS. ONCE THE RESERVOIR LEVEL RISES ABOVE ABOUT EL 1995 FT, THE EFFECTS OF WEIR FLOW OVER THE SPILLWAY AND/OR EMBANKMENT BECOMES DROWNED OUT, SUCH THAT THE RESERVOIR LEVEL IS DICTATED BY THE TAILWATER LEVEL. THEREFORE, FLOW OVER THE EMBANKMENT IS INCLUDED IN THE "FINAL Q" VALUES ON SHEET 9 FOR ELEVATIONS ABOVE ABOUT EL 1994.1 FT (LOW TOP OF DAM)

SUBJECT DAM SAFETY INSPECTION

LAUREL HILL CREEK DAM

BY WJV DATE 8-20-79 PROJ. NO. 78-617-235

CHKD. BY DXX DATE 9-14-79 SHEET NO. 9 OF 15

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- SPILLWAY RATING CURVE

RESERVOIR ELEVATION (FT)	① H (FT)	② H/H_o (FT/FT)	③ C/C_o	④ C	⑤ INITIAL Q (CFS)	⑥ TAILWATER ELEVATION (FT)	⑦ h_d/H (FT/FT)	⑧ C_s/C	⑨ C_s	⑩ FINAL Q (CFS)
1952.0	0	-	-	-	0	1975.0	-	-	-	0
1953.0	1.0	0.08	0.82	2.73	410	1979.8	3.2	1.0	2.73	410
1954.0	2.0	0.17	0.84	2.80	1190	1983.6	0.2	0.86	2.41	1020
1955.0	3.0	0.25	0.86	2.86	2230	1985.0	0	-	-	2230
1956.0	4.0	0.33	0.88	2.93	3520	1986.7	-	-	-	2920
1958.0	6.0	0.50	0.92	3.06	6750	1989.9	-	-	-	4670
1960.0	8.0	0.66	0.95	3.16	10730	1993.0	-	-	-	6920
1962.0	10.0	0.83	0.98	3.26	15460	1996.2	-	-	-	9490
1964.0	12.0	0.99	1.0	3.33	20760	1999.3	-	-	-	12070
LOW TOP OF DAM 1964.1	12.1	1.0	1.0	3.33	21020	1999.4	-	-	-	12200
1965.0	13.0	1.07	1.01	3.36	23620	2000.7	-	-	-	* 13610
1966.9	14.9	1.23	1.03	3.43	29590	2003.4	-	-	-	* 16600
1969.4	17.4	1.44	1.05	3.50	38110	2006.7	-	-	-	* 21000
2001.6	19.6	1.62	1.07	3.56	46340	2009.4	-	-	-	* 25400
2003.5	21.5	1.78	1.08	3.60	53830	2011.6	-	-	-	* 29800
2005.3	23.3	1.93	1.09	3.63	61240	> 2012	-	-	-	* 34200
2007.1	27.1	2.24	1.10	3.66	77450	> 2012	-	-	-	* 45200

* INCLUDES FLOW OVER EMBANKMENT

① H = RESERVOIR ELEV - 1952.0 FT ; ② H_o = 12.1 FT ; ③ C/C_o ⇒ REF 4, PG 378, FIG 250 ; ④ C = 3.33 × C/C_o ; ⑤ Q = C (150 FT) $H^{3/2}$; ⑥ INTERPOLATED FROM SHEET 11, EXCEPT FOR PARTIAL SPILLWAY DISCHARGE ONLY ; ⑦ h_d = RESERVOIR ELEV - TAILWATER ELEV ; ⑧ C_s/C ⇒ REF 4, PG 382, FIG 254 ; ⑨ C_s = C × C_s/C ; ⑩ Q = C_s (150 FT) $H^{3/2}$ UNLESS TAILWATER ELEV > C_s FROM SHEET 11, CORRESPONDING TO RESERVOIR ELEV (TOTAL FACILITY FLOWS)

SUBJECT DAM SAFETY INSPECTION
LAUREL HILL CREEK DAM

BY WJV DATE 8-20-79 PROJ. NO. 78-617-235

CHKD. BY JJS DATE 9-14-79 SHEET NO. 10 OF 15

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TAILWATER RATING CURVE

DUE TO THE HEIGHT OF THE SPILLWAY CREST ABOVE THE DISCHARGE CHANNEL (ONLY ≈ 7FT), AND TO THE VERY FLAT GRADIENT OF THE DISCHARGE CHANNEL AND VALLEY (≈ 0.1%) FOR AT LEAST THE FIRST 4 MILES DOWNSTREAM FROM THE DAM, A BACKWATER CURVE WAS COMPUTED SO AS TO ASCERTAIN THE EFFECTS OF TAILWATER ON SPILLWAY DISCHARGES. THE BACKWATER CURVE WAS CALCULATED VIA THE HEC-2 WATER SURFACE PROFILE COMPUTER PROGRAM*. HEC-2 COMPUTES BACKWATER BY THE STANDARD STEP METHOD (REF 7, PG 274-290), BASED ON VALLEY AND CHANNEL CROSS-SECTION INFORMATION. THE SPECIFIC CROSS-SECTION DATA USED IS GIVEN ON SHEETS 12 THROUGH 15. THE COMPUTATIONS WERE INITIATE AT A SECTION (SECTION 9, SHEET 15) LOCATED ABOUT 4 MILES DOWNSTREAM FROM THE DAM BY THE SLOPE-AREA METHOD (REF 7, PG 146-149). THE CALCULATIONS THEN PROCEEDED UPSTREAM THROUGH 4 "NATURAL SECTIONS" AND 2 BRIDGES, AND FINALLY TO THE VALLEY SECTION @ THE TOE OF THE DAM (SECTION 2, SHEET 12).

THE RATING TABLE GIVEN ON SHEET 11 CORRESPONDS TO THE HEC-2 OUTPUT FOR SECTION 2 (SUMMARY INPUT/OUTPUT SHEETS, SHEET 6).

* HEC-2 WATER SURFACE PROFILES (USERS MANUAL)
HYDROLOGIC ENGINEERING CENTER, U.S. ARMY CORPS OF ENGINEERS, DAVIS CALIFORNIA, NOV. 1976.

SUBJECT DAM SAFETY INSPECTION
LAUREL HILL CREEK DAM

BY WJV DATE 8-20-79 PROJ. NO. 78-617-235

CHKD. BY DJS DATE 9-14-79 SHEET NO. 11 OF 15

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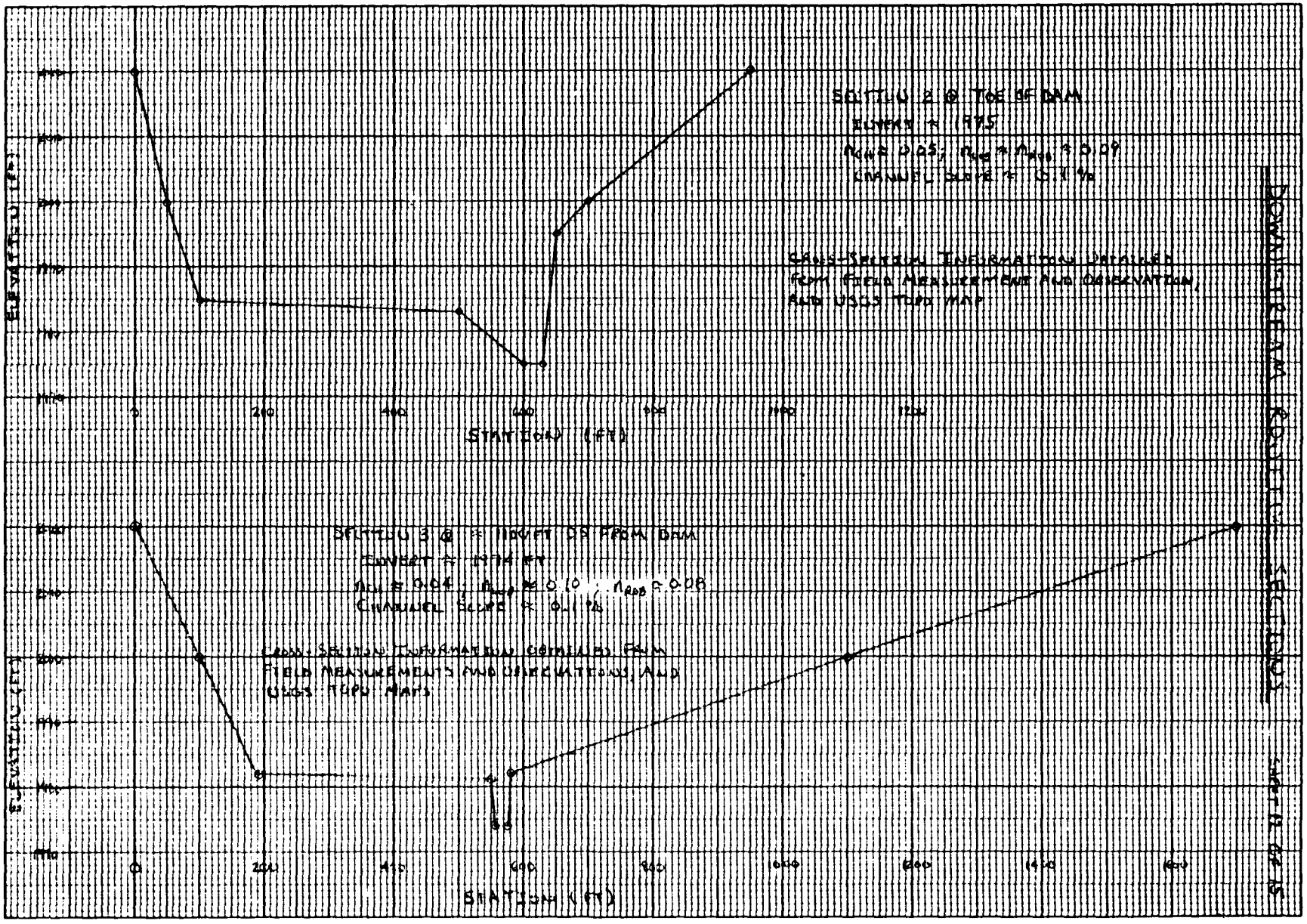
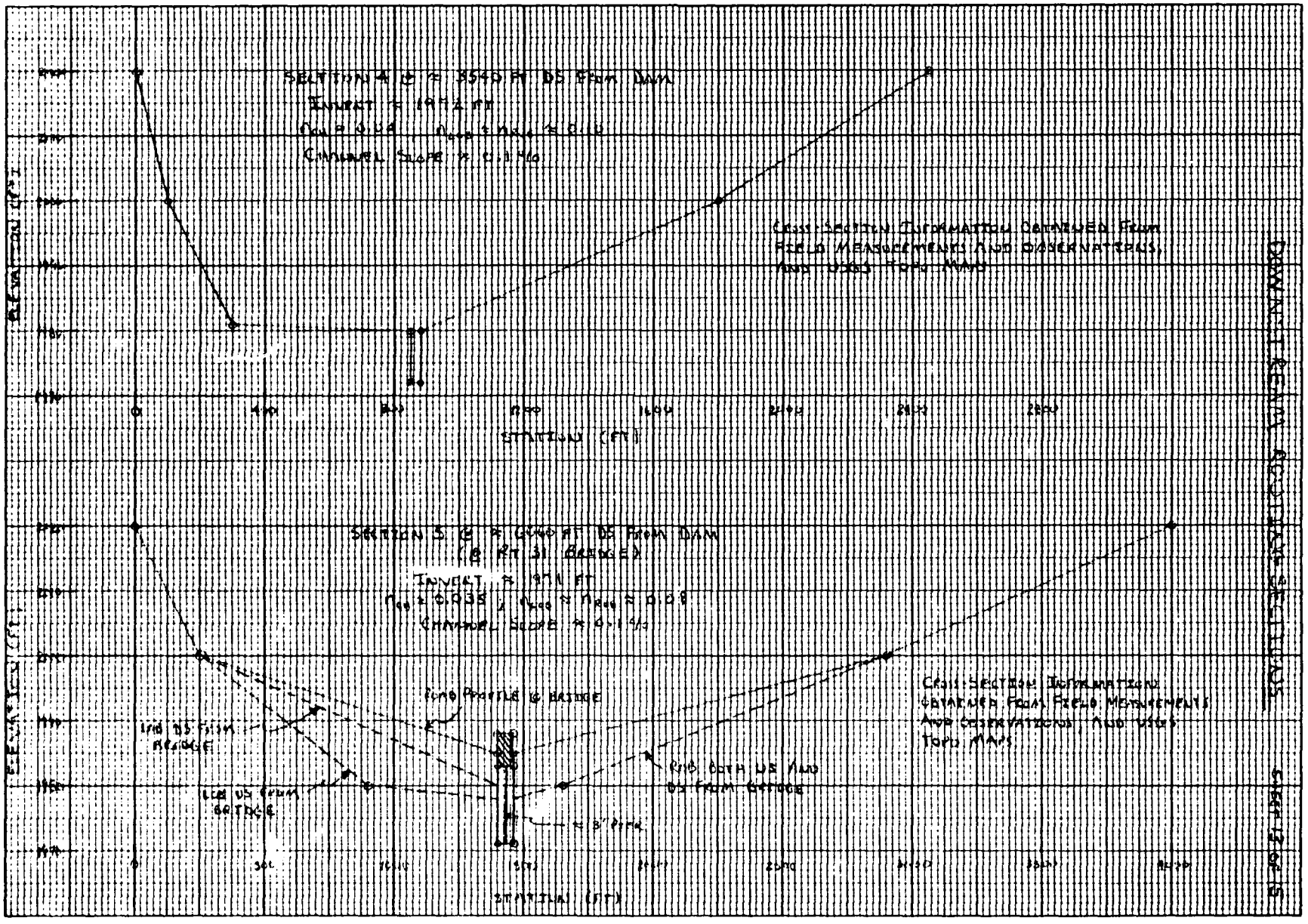
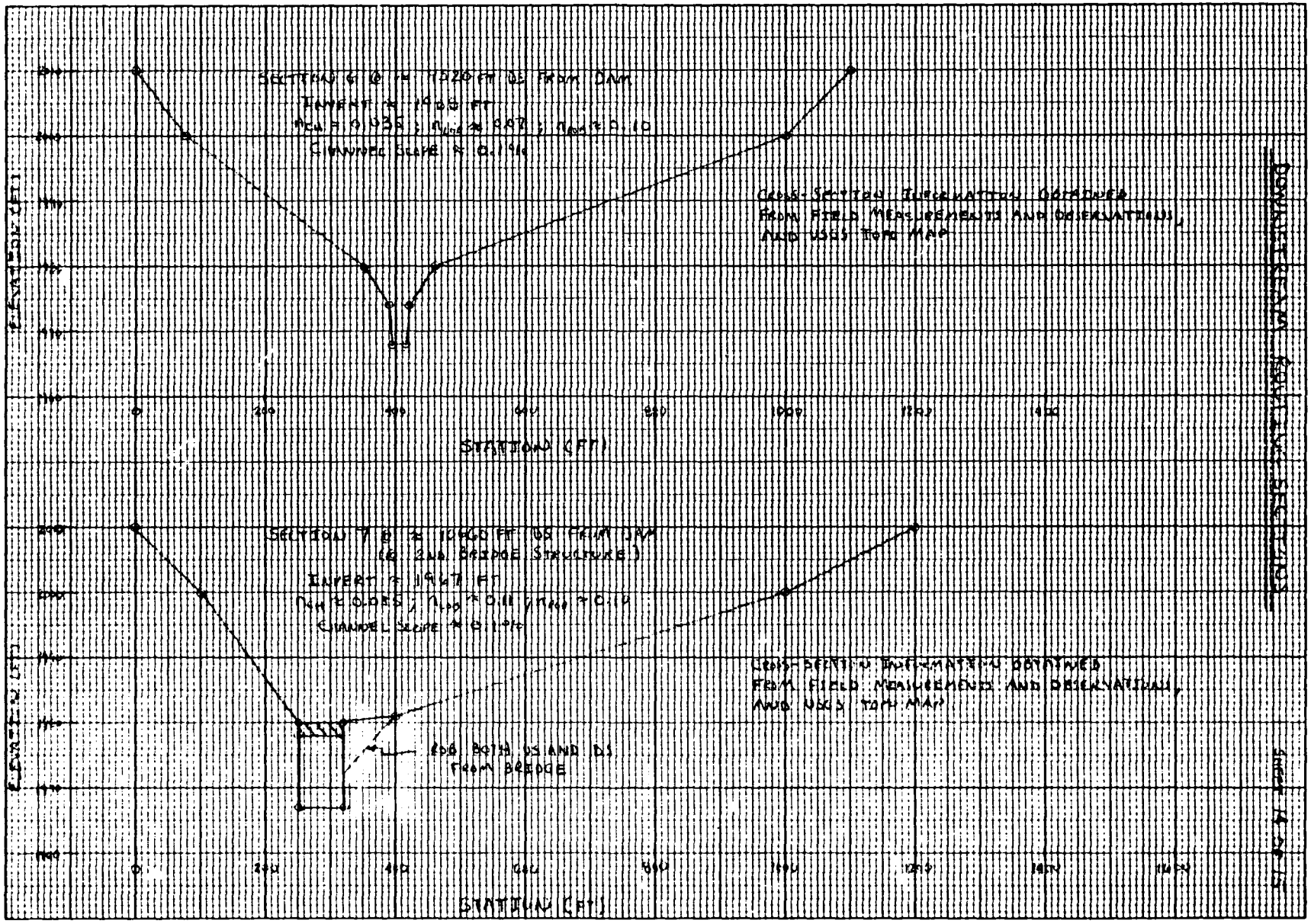
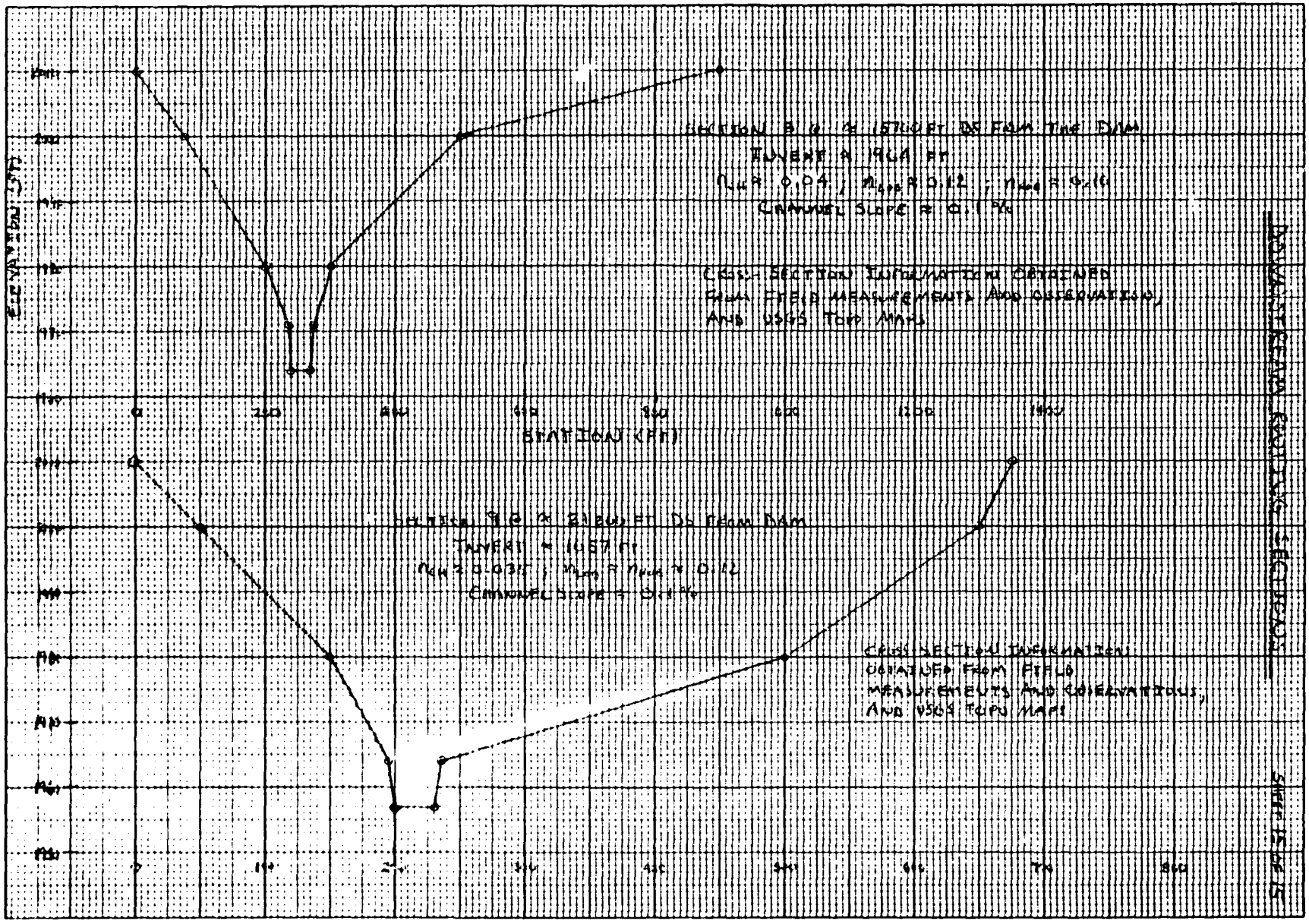
- TAILWATER RATING CURVE :

ELEVATION (FT)	DISCHARGE (CFS)
1975.0	0
1980.9	500
1983.3	1000
1986.4	3200
1989.9	5500
1990.6	7700
1992.4	10000
1994.1	12200
1996.9	16600
1999.4	21000
2001.6	25400
2003.5	29800
2005.3	34200
2009.1	45200
2012.3	56200


SECTION 2 @ TOE OF DAM
ELEVATION = 1975
MANNING'S n: n_LOB = n_ROB = 0.09
CHANNEL n = 0.04
CROSS-SECTIONAL INFORMATION OBTAINED FROM FIELD MEASUREMENTS AND OBSERVATIONS, AND USGS TOPO MAP
SECTION 3 @ = 1800 FT DS FROM DAM
ELEVATION = 1934 FT
n_LOB = 0.04 ; n_CHAN = 0.10 ; n_ROB = 0.08
CHANNEL SLOPE = 0.1 %
CROSS-SECTIONAL INFORMATION OBTAINED FROM FIELD MEASUREMENTS AND OBSERVATIONS, AND USGS TOPO MAPS
ELEVATION (FT)
STATION (FT)
POWDER RIVER BASIN RESOURCE COUNCIL


SECTION 4 @ ≈ 3540 FT DS FROM DAM
INVERT ≈ 1914 FT
CHANNEL SLOPE ≈ 0.1%
Cross-Section Information Obtained From Field Measurements And Observations, And Using Topo Maps
ELEVATION (FT)
STATION (FT)
SECTION 5 @ ≈ 6000 FT DS FROM DAM
(@ RT 31 BRIDGE)
INVERT ≈ 1911 FT
CHANNEL SLOPE ≈ 0.1%
Cross-Section Information Obtained From Field Measurements And Observations, And Using Topo Maps
Road Profile @ Bridge
Rip Rap DS From Bridge
Rip Both DS And DS From Bridge
≈ 8' Piers
STATION (FT)
ELEVATION (FT)


SECTION 6 @ R = 11020 FT DS FROM DAM
INVERT = 1900 FT
CHANNEL SCALE = 0.1"/ft
CROSS-SECTION INTERPOLATION BASED ON
FROM FIELD MEASUREMENTS AND OBSERVATIONS,
AND USGS TOPO MAP
ELEVATION (FT)
STATION (FT)
SECTION 7 @ R = 11960 FT DS FROM DAM
(@ 2nd BRIDGE STRUCTURE)
INVERT = 1947 FT
CHANNEL SCALE = 0.1"/ft
ROB BOTH US AND DS
FROM BRIDGE
CROSS-SECTION INTERPOLATION BASED ON
FROM FIELD MEASUREMENTS AND OBSERVATIONS,
AND USGS TOPO MAP
ELEVATION (FT)
STATION (FT)


ELEVATION (FT)
STATION (FT)
SECTION B @ ± 1570 FT DS FROM THE DAM
TRIVERT ≈ 1964 FT
n_LOB = 0.04 ; n_MCB = 0.12 ; n_ROB = 0.11
CHANNEL SLOPE = 0.1 %
CROSS-SECTIONAL INFORMATION OBTAINED FROM FIELD MEASUREMENTS AND OBSERVATIONS AND USGS TOPO MAPS
SECTION A @ ± 2180 FT DS FROM DAM
THALWEG = 1957 FT
n_LOB = 0.031 ; n_MCB = n_ROB = 0.11
CHANNEL SLOPE = 0.1 %
CROSS-SECTIONAL INFORMATION OBTAINED FROM FIELD MEASUREMENTS AND OBSERVATIONS, AND USGS TOPO MAPS
DOWNSTREAM CROSS-SECTIONS (ECHEAC)
SHEET 15 OF 15

SUMMARY INPUT/OUTPUT SHEETS

HEC-2 BACKWATER CURVE COMPUTATIONS FOR TAILWATER ON DAM

SUBJECT DAM SAFETY INSPECTION
LAUREL HILL CREEK DAM
BY WJV DATE 9-3-79
CHKD. BY DLD DATE 9-4-79
PROJ. NO. 78-617-235
SHEET NO. A OF K

UCI CONSULTANTS, INC
Engineers • Geologists • Planners
Environmental Specialists

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 I1 DAM SAFETY INSPECTION - DOWNSTREAM ROUTING INFORMATION
 I2 START CALCULATIONS VIA SLOPE-AREA METHOD, MODEL BRIDGES W/ SPECIAL BRIDGE
 I3       LAUREL HILL CREEK BELOW LAUREL HILL CREEK DAM

 J1  ICHECK      INQ          NINV         IDIR         STRT         METRIC       HVINS        Q            WSEL         FQ
                                                                                                                        
             0.           2.           0.           0.  0.001000         0.0          0.0          0.  1960.000         0.0

 J2  NPROF       IPLOT        PRFVS        XSECV        XSECH        FN           ALLDC        IBW          CHNIM        ITRACE
                                                                                                                        
             1.000        0.0          0.0          0.0          0.0          0.0          0.0          0.0          0.0

 J3  VARIABLE CODES FOR SUMMARY PRINTOUT
                                                                                                                        
            38.000       39.000       42.000       43.000        1.000        2.000        3.000       26.000       25.000        7.000

 J5  LPRNT    KODSEL                                  ********REQUESTED SECTION NUMBERS********
                                                                                                                        
           -10.000      -10.000          0.0          0.0          0.0          0.0          0.0          0.0          0.0          0.0
 NC          0.120        0.120        0.035        0.200        0.400          0.0          0.0          0.0          0.0          0.0
 QT         14.000      500.000     1000.000     3200.000     5500.000     7700.000    10000.000    12200.000    16600.000    21000.000
 QT      25400.000    29800.000    34700.000    45200.000    56200.000          0.0          0.0          0.0          0.0          0.0

 X1          9.000       10.000      195.000      235.000          0.0          0.0          0.0          0.0          0.0          0.0
 GR       2010.000        0.0        2000.000       50.000     1980.000      150.000     1964.000      195.000     1957.000      200.000
 GR       1957.000      230.000     1964.000      235.000     1980.000      500.000     2000.000      650.000     2010.000      675.000
 NC          0.120        0.100        0.040        0.200        0.400          0.0          0.0          0.0          0.0          0.0

 X1          4.000       10.000      235.000      275.000     5500.000     5500.000     5500.000          0.0          0.0          0.0
 GR       2010.000        0.0        2000.000       75.000     1980.000      200.000     1971.000      235.000     1964.000      240.000
 GR       1964.000      270.000     1971.000      275.000     1980.000      300.000     2000.000      500.000     2010.000      900.000
 NC          0.110        0.100        0.035        0.200        0.400          0.0          0.0          0.0          0.0          0.0

 X1          7.900        9.000      250.000      320.000     4940.000     4940.000     4940.000          0.0          0.0          0.0
 GR       2010.000        0.0        2000.000      100.000     1980.000      250.000     1967.000      250.000     1967.000      320.000
 GR       1972.000      320.000     1981.000      400.000     2000.000     1000.000     2010.000     1200.000          0.0          0.0
 NC          0.110        0.100        0.035        0.500        0.700          0.0          0.0          0.0          0.0          0.0

 X1          7.900          0.0          0.0          0.0      100.000      100.000      100.000          0.0          0.0          0.0
 X3         10.000          0.0          0.0          0.0          0.0          0.0          0.0     1979.000     1979.000          0.0
 NC          0.110        0.100        0.035        0.200        0.400          0.0          0.0          0.0          0.0          0.0
 SB          0.900        1.500        2.900          0.0       70.000          0.0      170.000          0.0          0.0          0.0

 X1          7.000          0.0          0.0          0.0       30.000       30.000       30.000          0.0          0.0          0.0
 X2          0.0            0.0        1.000     1978.000     1980.000          0.0          0.0          0.0          0.0          0.0
 X3         10.000          0.0          0.0          0.0          0.0          0.0          0.0     1980.000     1980.000          0.0
 GR          0.000          0.0     2010.000          0.0      100.000     2000.000          0.0      250.000     1980.000          0.0
 GR        250.000     1980.000     1978.000      320.000     1980.000     1978.000      320.000     1980.000          0.0      400.000
 GR       1941.000          0.0     1000.000     2000.000          0.0     1200.000     2010.000          0.0          0.0          0.0
 NC          0.110        0.100        0.035        0.500        0.700          0.0          0.0          0.0          0.0          0.0
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SUBJECT DAM SAFETY INSPECTION
LAUREL HILL CREEK DAM

BY WJV DATE 9-3-79 PROJ. NO. 78-617-235
CHKD. BY DLB DATE 9-4-79 SHEET NO. B OF K

GAI CONSULTANTS, INC.
Engineers • Geologists • Planners
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X1	6.900	0.0	0.0	0.0	100.000	100.000	100.000	0.0	0.0	0.0
NC	0.070	0.100	0.035	0.200	0.400	0.0	0.0	0.0	0.0	0.0
X1	6.000	10.000	390.000	420.000	1040.000	1040.000	1040.000	0.0	0.0	0.0
GR	2010.000	0.0	2000.000	75.000	1980.000	350.000	1974.000	390.000	1968.000	395.000
GR	1968.000	415.000	1974.000	420.000	1980.000	460.000	2000.000	1000.000	2010.000	1100.000
NC	0.080	0.080	0.035	0.200	0.400	0.0	0.0	0.0	0.0	0.0
X1	5.900	9.000	1400.000	1460.000	3360.000	3360.000	3360.000	0.0	0.0	0.0
GR	2020.000	0.0	2000.000	250.000	1980.000	1400.000	1971.000	1400.000	1971.000	1460.000
GR	1974.000	1460.000	1980.000	1650.000	2000.000	2900.000	2020.000	4000.000	0.0	0.0
NC	0.080	0.080	0.035	0.500	0.700	0.0	0.0	0.0	0.0	0.0
X1	5.600	0.0	0.0	0.0	100.000	100.000	100.000	0.0	0.0	0.0
X3	10.000	0.0	0.0	0.0	0.0	0.0	0.0	1984.000	1984.000	0.0
NC	0.080	0.080	0.035	0.200	0.400	0.0	0.0	0.0	0.0	0.0
SB	0.900	1.600	2.900	0.0	60.000	0.0	684.000	0.0	0.0	0.0
X1	5.000	12.000	1400.000	1460.000	30.000	30.000	30.000	0.0	0.0	0.0
X2	0.0	0.0	1.000	1983.000	1985.000	0.0	0.0	0.0	0.0	0.0
X3	10.000	0.0	0.0	0.0	0.0	0.0	0.0	1985.000	1985.000	0.0
BT	10.000	0.0	2020.000	0.0	250.000	2000.000	0.0	1400.000	1985.000	0.0
BT	1400.000	1988.000	1983.000	1430.000	1988.000	1983.000	1433.000	1988.000	1983.000	1460.000
BT	1988.000	1983.000	1460.000	1985.000	0.0	2900.000	2000.000	0.0	4000.000	2020.000
BT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GR	2020.000	0.0	2000.000	250.000	1980.000	900.000	1978.000	1400.000	1971.000	1400.000
GR	1971.000	1430.000	1971.000	1433.000	1971.000	1460.000	1978.000	1460.000	1980.000	1650.000
GR	2000.000	2900.000	2020.000	4000.000	0.0	0.0	0.0	0.0	0.0	0.0
NC	0.060	0.080	0.035	0.500	0.700	0.0	0.0	0.0	0.0	0.0
X1	4.900	0.0	0.0	0.0	100.000	100.000	100.000	0.0	0.0	0.0
NC	0.100	0.100	0.040	0.300	0.500	0.0	0.0	0.0	0.0	0.0
X1	4.000	9.000	850.000	880.000	2420.000	2420.000	2420.000	0.0	0.0	0.0
GR	2020.000	0.0	2000.000	100.000	1981.000	300.000	1980.000	850.000	1972.000	850.000
GR	1972.000	880.000	1980.000	880.000	2000.000	1800.000	2020.000	2450.000	0.0	0.0
NC	0.100	0.080	0.040	0.200	0.400	0.0	0.0	0.0	0.0	0.0
X1	3.000	9.000	550.000	580.000	2440.000	2440.000	2440.000	0.0	0.0	0.0
GR	2020.000	0.0	2000.000	100.000	1982.000	190.000	1981.000	550.000	1974.000	555.000
GR	1974.000	575.000	1982.000	580.000	2000.000	1100.000	2020.000	1700.000	0.0	0.0
NC	0.090	0.070	0.050	0.200	0.400	0.0	0.0	0.0	0.0	0.0
X1	2.000	9.000	500.000	650.000	1100.000	1100.000	1100.000	0.0	0.0	0.0
GR	2020.000	0.0	2000.000	50.000	1985.000	100.000	1983.000	500.000	1975.000	600.000
GR	1975.000	630.000	1995.000	650.000	2000.000	700.000	2020.000	950.000	0.0	0.0
[illegible]	[illegible]	[illegible]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

SUBJECT DAM SAFETY INSPECTION
LAUREL HILL CREEK DAM

BY WJV DATE 9-3-79 PROJ. NO. 78-617-235

CHKD. BY DLB DATE 9-4-79 SHEET NO. C OF K

GAI CONSULTANTS, INC
Engineers • Geologists • Planners
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SUMMARY PRINTOUT

SECNO	ARCH	MAXEL	DISCHARGE Q	ELEVATION CWSEL	CRIWS	EG	VCH	AREA	VOL
9.000	0.0	1957.00	500.00	1961.64	0.0	1961.80	3.23	154.64	0.0
9.000	0.0	1957.00	1000.00	1964.05	0.0	1964.30	4.05	246.85	0.0
9.000	0.0	1957.00	3200.00	1969.70	0.0	1970.26	6.25	787.66	0.0
9.000	0.0	1957.00	5500.00	1973.28	0.0	1974.00	7.46	1450.49	0.0
9.000	0.0	1957.00	7700.00	1975.88	0.0	1976.71	8.26	2088.31	0.0
9.000	0.0	1957.00	10000.00	1978.13	0.0	1979.04	8.92	2745.04	0.0
9.000	0.0	1957.00	12200.00	1980.00	0.0	1980.96	9.44	3365.00	0.0
9.000	0.0	1957.00	16600.00	1982.76	0.0	1983.80	10.28	4380.34	0.0
9.000	0.0	1957.00	21000.00	1985.21	0.0	1986.30	10.93	5357.72	0.0
9.000	0.0	1957.00	25400.00	1987.39	0.0	1988.53	11.50	6293.21	0.0
9.000	0.0	1957.00	29800.00	1989.37	0.0	1990.56	12.01	7194.17	0.0
9.000	0.0	1957.00	34200.00	1991.20	0.0	1992.42	12.47	8067.37	0.0
9.000	0.0	1957.00	45200.00	1995.27	0.0	1996.59	13.45	10166.15	0.0
9.000	0.0	1957.00	56200.00	1998.80	0.0	2000.21	14.29	12155.60	0.0
8.000	5500.00	1964.00	500.00	1968.41	0.0	1968.59	3.43	145.95	18.98
8.000	5500.00	1964.00	1000.00	1970.75	0.0	1971.03	4.26	234.88	30.41
8.000	5500.00	1964.00	3200.00	1976.42	0.0	1977.10	6.72	559.70	85.06
8.000	5500.00	1964.00	5500.00	1980.12	0.0	1981.12	8.35	886.33	147.53
8.000	5500.00	1964.00	7700.00	1982.75	0.0	1983.98	9.47	1211.16	208.30
8.000	5500.00	1964.00	10000.00	1985.01	0.0	1986.43	10.40	1579.25	273.00
8.000	5500.00	1964.00	12200.00	1986.86	0.0	1988.41	11.12	1942.82	335.09
8.000	5500.00	1964.00	16600.00	1989.75	0.0	1991.57	12.44	2621.97	442.07
8.000	5500.00	1964.00	21000.00	1992.20	0.0	1994.21	13.45	3306.24	546.97
8.000	5500.00	1964.00	25400.00	1994.37	0.0	1996.51	14.25	3992.72	649.36
8.000	5500.00	1964.00	29800.00	1996.34	0.0	1998.57	14.92	4679.33	749.59
8.000	5500.00	1964.00	34200.00	1998.14	0.0	2000.45	15.47	5365.37	848.03
8.000	5500.00	1964.00	45200.00	2002.12	0.0	2004.44	16.32	7134.87	1092.24
8.000	5500.00	1964.00	56200.00	2005.55	0.0	2007.76	16.70	9220.08	1349.47

SECTION @ ≈ 21200 FT DS FROM DAM

SECTION @ ≈ 15700 FT DS FROM DAM

SUBJECT DAM SAFETY INSPECTION
LAUREL HILL CREEK DAM

BY WJV DATE 9-3-79 PROJ. NO. 78-617-235

CHKD. BY DLB DATE 9-4-79 SHEET NO. 5 OF K

CONSULTANTS, INC
Engineers • Geologists • Planners
Environmental Specialists

			DISCHARGE	ELEVATION					
SECTION	RICH	ELMIN	Q	CWSEL	CWLWS	EG	VCH	AREA	VOL
1.000	4940.00	1961.00	500.00	1971.22	0.0	1971.27	1.69	296.25	44.05
1.000	4940.00	1961.00	1000.00	1973.57	0.0	1973.64	2.17	470.18	70.42
1.000	4940.00	1961.00	3200.00	1979.81	0.0	1979.98	3.38	1167.95	183.02
1.000	4940.00	1961.00	5500.00	1983.92	0.0	1984.15	4.11	1969.44	309.46
1.000	4940.00	1961.00	7700.00	1986.82	0.0	1987.09	4.53	2921.66	442.65
1.000	4940.00	1961.00	10000.00	1989.28	0.0	1989.57	4.92	3985.73	588.55
1.000	4940.00	1961.00	12200.00	1991.27	0.0	1991.58	5.19	5072.35	730.04
1.000	4940.00	1961.00	16600.00	1994.50	0.0	1994.83	5.64	7029.17	989.32
1.000	4940.00	1961.00	21000.00	1997.17	0.0	1997.52	5.98	9002.14	1244.89
1.000	4940.00	1961.00	25400.00	1999.49	0.0	1999.84	6.27	10935.71	1495.86
1.000	4940.00	1961.00	29800.00	2001.52	0.0	2001.86	6.43	12789.33	1740.12
1.000	4940.00	1961.00	34200.00	2003.35	0.0	2003.70	6.56	14576.35	1978.79
1.000	4940.00	1961.00	45200.00	2007.25	0.0	2007.59	6.91	18704.05	2557.39
1.000	4940.00	1961.00	56200.00	2010.48	0.0	2010.83	7.26	22465.71	3146.17
1.000	100.00	1961.00	500.00	1971.25	0.0	1971.30	1.68	297.67	44.73
1.000	100.00	1961.00	1000.00	1973.59	0.0	1973.67	2.17	461.59	71.50
1.000	100.00	1961.00	3200.00	1979.84	0.0	1980.01	3.37	1171.81	185.71
1.000	100.00	1961.00	5500.00	1983.95	0.0	1984.18	4.10	1977.28	313.99
1.000	100.00	1961.00	7700.00	1986.85	0.0	1987.12	4.56	2933.05	449.37
1.000	100.00	1961.00	10000.00	1989.31	0.0	1989.60	4.91	4000.34	597.72
1.000	100.00	1961.00	12200.00	1991.30	0.0	1991.61	5.18	5039.26	741.59
1.000	100.00	1961.00	16600.00	1994.53	0.0	1994.86	5.63	7050.20	1005.48
1.000	100.00	1961.00	21000.00	1997.20	0.0	1997.55	5.97	9026.23	1265.59
1.000	100.00	1961.00	25400.00	1999.52	0.0	1999.87	6.25	10963.25	1520.99
1.000	100.00	1961.00	29800.00	2001.55	0.0	2001.89	6.41	12817.52	1769.51
1.000	100.00	1961.00	34200.00	2003.38	0.0	2003.72	6.55	14604.64	2012.28
1.000	100.00	1961.00	45200.00	2007.28	0.0	2007.62	6.90	18734.63	2600.36
1.000	100.00	1961.00	56200.00	2010.51	0.0	2010.86	7.25	22499.01	3197.78
2.000	30.00	1961.00	500.00	1971.26	0.0	1971.30	1.68	297.65	44.94
2.000	30.00	1961.00	1000.00	1973.60	0.0	1973.68	2.17	461.61	71.81
2.000	30.00	1961.00	3200.00	1980.10	0.0	1980.26	3.30	1208.67	186.53
2.000	30.00	1961.00	5500.00	1984.04	0.0	1984.27	4.07	2002.90	315.36
2.000	30.00	1961.00	7700.00	1986.88	0.0	1987.14	4.55	2944.12	451.39
2.000	30.00	1961.00	10000.00	1989.31	0.0	1989.60	4.91	4000.52	600.47
2.000	30.00	1961.00	12200.00	1991.30	0.0	1991.61	5.18	5039.66	745.06
2.000	30.00	1961.00	16600.00	1994.53	0.0	1994.86	5.63	7050.27	1010.33
2.000	30.00	1961.00	21000.00	1997.20	0.0	1997.55	5.97	9026.36	1271.80
2.000	30.00	1961.00	25400.00	1999.52	0.0	1999.87	6.25	10963.09	1528.54
2.000	30.00	1961.00	29800.00	2001.57	0.0	2001.92	6.40	12840.47	1778.35
2.000	30.00	1961.00	34200.00	2003.44	0.0	2003.78	6.52	14663.37	2022.36
2.000	30.00	1961.00	45200.00	2007.32	0.0	2007.72	6.86	18853.63	2613.31
2.000	30.00	1961.00	56200.00	2010.64	0.0	2010.99	7.20	22663.06	3213.33

SECTION @ ≈ 10760 FT DS FROM DAM (@ ≈ 100 FT DS FROM BRIDGE)

SECTION @ ≈10 FT DS FROM DAM (@ US FACE OF BRIDGE)

SECTION @ ≈ 10760 FT DS FROM DAM (@ US FACE OF BRIDGE)

SUBJECT DAM SAFETY INSPECTION

LAUREL HILL CREEK DAM

BY WJY DATE 9-3-79 PROJ. NO. 78-617-235

CHKD. BY JDB DATE 9-4-79 SHEET NO. E OF K

UCI CONSULTANTS, INC

Engineers • Geologists • Planners
Environmental Specialists

	SECNO	ALCH	ELMIN	DISCHARGE Q	ELEVATION CWSEL	CHIWS	EG	VCH	AREA	VOL
SECTION @ = 10500 FT DS FROM DAM (@ = 100 FT US FROM BRIDGE)	6.900	100.00	1967.00	500.00	1971.29	0.0	1971.33	1.67	300.05	45.62
	6.900	100.00	1967.00	1000.00	1973.63	0.0	1973.70	2.15	475.71	72.89
	6.900	100.00	1967.00	3200.00	1980.13	0.0	1980.29	3.29	1212.56	189.31
	6.900	100.00	1967.00	5500.00	1984.07	0.0	1984.30	4.06	2010.77	319.97
	6.900	100.00	1967.00	7700.00	1986.91	0.0	1987.17	4.54	2955.22	458.16
	6.900	100.00	1967.00	10000.00	1989.34	0.0	1989.63	4.90	4014.30	609.67
	6.900	100.00	1967.00	12200.00	1991.33	0.0	1991.64	5.17	5055.39	756.65
	6.900	100.00	1967.00	16600.00	1994.56	0.0	1994.89	5.62	7069.76	1026.54
	6.900	100.00	1967.00	21000.00	1997.23	0.0	1997.58	5.96	9048.64	1292.55
	6.900	100.00	1967.00	25400.00	1999.55	0.0	1999.90	6.24	10987.70	1553.74
	6.900	100.00	1967.00	29800.00	2001.60	0.0	2001.94	6.39	12866.18	1807.86
	6.900	100.00	1967.00	34200.00	2003.47	0.0	2003.80	6.51	14689.66	2056.05
	6.900	100.00	1967.00	45200.00	2007.41	0.0	2007.75	6.85	18881.97	2656.62
	6.900	100.00	1967.00	56200.00	2010.67	0.0	2011.01	7.19	22693.32	3265.39
SECTION @ = 9520 FT DS FROM DAM	6.000	1040.00	1968.00	500.00	1971.70	0.0	1972.23	5.86	85.33	50.22
	6.000	1040.00	1968.00	1000.00	1973.91	0.0	1974.63	6.80	147.04	80.32
	6.000	1040.00	1968.00	3200.00	1980.26	0.0	1981.16	8.17	399.88	210.94
	6.000	1040.00	1968.00	5500.00	1984.31	0.0	1985.03	8.16	1421.38	360.94
	6.000	1040.00	1968.00	7700.00	1987.21	0.0	1987.79	7.94	2420.98	522.34
	6.000	1040.00	1968.00	10000.00	1989.68	0.0	1990.16	7.74	3543.10	699.89
	6.000	1040.00	1968.00	12200.00	1991.69	0.0	1992.10	7.61	4639.24	872.38
	6.000	1040.00	1968.00	16600.00	1994.93	0.0	1995.29	7.55	6757.63	1191.61
	6.000	1040.00	1968.00	21000.00	1997.64	0.0	1997.95	7.54	8846.35	1506.17
	6.000	1040.00	1968.00	25400.00	1999.97	0.0	2000.26	7.57	10896.25	1814.98
	6.000	1040.00	1968.00	29800.00	2002.03	0.0	2002.29	7.41	12832.08	2114.63
	6.000	1040.00	1968.00	34200.00	2003.89	0.0	2004.13	7.34	14651.10	2406.31
	6.000	1040.00	1968.00	45200.00	2007.83	0.0	2008.05	7.41	18697.23	3105.22
	6.000	1040.00	1968.00	56200.00	2011.09	0.0	2011.31	7.61	22242.49	3801.82
SECTION @ = 6150 FT DS FROM DAM (@ = 100 FT DS FROM BRIDGE)	5.900	3360.00	1971.00	500.00	1975.27	0.0	1975.32	1.96	255.75	63.38
	5.900	3360.00	1971.00	1000.00	1977.58	0.0	1977.68	2.53	394.83	101.22
	5.900	3360.00	1971.00	3200.00	1983.14	0.0	1983.26	3.20	2101.15	315.12
	5.900	3360.00	1971.00	5500.00	1986.37	0.0	1986.45	3.06	4757.89	599.26
	5.900	3360.00	1971.00	7700.00	1988.80	0.0	1988.86	2.91	7573.52	907.80
	5.900	3360.00	1971.00	10000.00	1990.96	0.0	1991.01	2.79	10676.93	1248.32
	5.900	3360.00	1971.00	12200.00	1992.78	0.0	1992.82	2.70	13730.06	1580.83
	5.900	3360.00	1971.00	16600.00	1995.83	0.0	1995.86	2.62	19723.55	2212.92
	5.900	3360.00	1971.00	21000.00	1998.42	0.0	1998.44	2.57	25679.75	2837.76
	5.900	3360.00	1971.00	25400.00	2000.67	0.0	2000.70	2.51	31528.61	3451.20
	5.900	3360.00	1971.00	29800.00	2002.64	0.0	2002.66	2.44	36965.83	4035.21
	5.900	3360.00	1971.00	34200.00	2004.45	0.0	2004.47	2.40	42196.05	4598.76
	5.900	3360.00	1971.00	45200.00	2008.33	0.0	2008.35	2.38	54151.80	5914.83
	5.900	3360.00	1971.00	56200.00	2011.57	0.0	2011.59	2.42	64924.64	7163.63

SUBJECT DAM SAFETY INSPECTION

LAUREL HILL CREEK DAM

BY WJV DATE 9-3-79 PROJ. NO. 78-617-235

CHKD. BY DLB DATE 9-4-79 SHEET NO. E OF K

GAI CONSULTANTS, INC

Engineers • Geologists • Planners
Environmental Specialists

	SECNO	ALCH	ELMIN	DISCHARGE Q	ELEVATION CHSEL	CRIWS	EG	VCH	AREA	VOL
SECTION @ ≈ 6960 FT DS FROM DAM (@ DS FACE OF BRIDGE)	5.800	100.00	1971.00	500.00	1975.30	0.0	1975.36	1.94	258.22	63.97
	5.800	100.00	1971.00	1000.00	1977.62	0.0	1977.72	2.52	397.17	102.13
	5.800	100.00	1971.00	3200.00	1983.12	0.0	1983.42	4.40	727.40	318.36
	5.800	100.00	1971.00	5500.00	1986.39	0.0	1986.47	3.05	4781.18	610.21
	5.800	100.00	1971.00	7700.00	1988.81	0.0	1988.87	2.90	7595.31	925.21
	5.800	100.00	1971.00	10000.00	1990.97	0.0	1991.02	2.79	10696.41	1272.85
	5.800	100.00	1971.00	12200.00	1992.79	0.0	1992.83	2.70	13747.41	1612.37
	5.800	100.00	1971.00	16600.00	1995.84	0.0	1995.87	2.61	19740.31	2258.22
	5.800	100.00	1971.00	21000.00	1998.42	0.0	1998.45	2.56	25721.20	2896.76
	5.800	100.00	1971.00	25400.00	2000.68	0.0	2000.70	2.50	31568.80	3523.63
	5.800	100.00	1971.00	29800.00	2002.65	0.0	2002.67	2.43	37002.70	4120.11
	5.800	100.00	1971.00	34200.00	2004.46	0.0	2004.48	2.39	42229.96	4695.67
	5.800	100.00	1971.00	45200.00	2008.34	0.0	2008.35	2.38	54183.48	6039.18
	5.800	100.00	1971.00	56200.00	2011.58	0.0	2011.60	2.42	64957.25	7312.71
SECTION @ ≈ 6030 FT DS FROM DAM (@ US FACE OF BRIDGE)	5.000	30.00	1971.00	500.00	1975.31	0.0	1975.37	1.93	258.49	64.15
	5.000	30.00	1971.00	1000.00	1977.63	0.0	1977.73	2.52	397.46	102.40
	5.000	30.00	1971.00	3200.00	1983.38	0.0	1983.67	4.31	742.73	318.87
	5.000	30.00	1971.00	5500.00	1987.27	0.0	1987.29	1.68	9206.75	615.02
	5.000	30.00	1971.00	7700.00	1989.16	0.0	1989.17	1.80	12092.10	931.99
	5.000	30.00	1971.00	10000.00	1991.15	0.0	1991.16	1.82	15507.79	1281.88
	5.000	30.00	1971.00	12200.00	1992.94	0.0	1992.96	1.83	18909.04	1623.62
	5.000	30.00	1971.00	16600.00	1995.97	0.0	1995.98	1.86	25338.47	2273.74
	5.000	30.00	1971.00	21000.00	1998.55	0.0	1998.56	1.90	31496.45	2916.46
	5.000	30.00	1971.00	25400.00	2000.81	0.0	2000.82	1.93	37404.07	3547.38
	5.000	30.00	1971.00	29800.00	2002.78	0.0	2002.79	1.94	42875.58	4147.62
	5.000	30.00	1971.00	34200.00	2004.59	0.0	2004.61	1.95	48133.36	4726.78
	5.000	30.00	1971.00	45200.00	2008.49	0.0	2008.50	2.03	60171.80	6078.55
	5.000	30.00	1971.00	56200.00	2011.74	0.0	2011.76	2.11	71029.19	7359.54
SECTION @ ≈ 5430 FT DS FROM DAM (@ ≈ 100 FT US FROM BRIDGE)	4.900	100.00	1971.00	500.00	1975.35	0.0	1975.41	1.92	260.95	64.74
	4.900	100.00	1971.00	1000.00	1977.67	0.0	1977.77	2.50	400.00	103.32
	4.900	100.00	1971.00	3200.00	1983.79	0.0	1983.82	1.85	4755.25	325.18
	4.900	100.00	1971.00	5500.00	1987.28	0.0	1987.29	1.68	9212.39	636.16
	4.900	100.00	1971.00	7700.00	1989.16	0.0	1989.18	1.80	12094.07	959.75
	4.900	100.00	1971.00	10000.00	1991.15	0.0	1991.17	1.82	15507.79	1317.48
	4.900	100.00	1971.00	12200.00	1992.95	0.0	1992.96	1.83	18907.29	1667.02
	4.900	100.00	1971.00	16600.00	1995.97	0.0	1995.99	1.86	25334.60	2331.90
	4.900	100.00	1971.00	21000.00	1998.55	0.0	1998.56	1.90	31490.55	2988.76
	4.900	100.00	1971.00	25400.00	2000.81	0.0	2000.82	1.93	37396.81	3633.24
	4.900	100.00	1971.00	29800.00	2002.78	0.0	2002.80	1.94	42866.92	4246.04
	4.900	100.00	1971.00	34200.00	2004.60	0.0	2004.61	1.96	48123.58	4837.27
	4.900	100.00	1971.00	45200.00	2008.49	0.0	2008.50	2.03	60158.80	6216.67
	4.900	100.00	1971.00	56200.00	2011.75	0.0	2011.76	2.11	71013.62	7522.57

SUBJECT DAM SAFETY INSPECTION

LAUREL HILL CREEK DAM

BY WJV DATE 9-3-79 PROJ. NO. 78-617-235

CHKD. BY DLB DATE 9-4-79 SHEET NO. G OF K

GAI CONSULTANTS, INC

Engineers • Geologists • Planners
Environmental Specialists

	SECNO	ALCH	ELMIN	DISCHARGE Q	ELEVATION CWSEL	CRIWS	EG	VCH	AREA	VOL
SECTION @ ≈3510 FT DS FROM DAM	4.000	2420.00	1972.00	500.00	1976.82	0.0	1977.01	3.46	144.56	76.01
	4.000	2420.00	1972.00	1000.00	1979.24	0.0	1979.57	4.61	217.03	120.46
	4.000	2420.00	1972.00	3200.00	1984.18	0.0	1984.26	3.46	2847.49	536.37
	4.000	2420.00	1972.00	5500.00	1987.50	0.0	1987.54	2.78	5830.24	1054.01
	4.000	2420.00	1972.00	7700.00	1989.38	0.0	1989.41	2.85	7793.99	1512.20
	4.000	2420.00	1972.00	10000.00	1991.34	0.0	1991.37	2.81	10063.95	2027.80
	4.000	2420.00	1972.00	12200.00	1993.11	0.0	1993.14	2.78	12299.62	2533.88
	4.000	2420.00	1972.00	16600.00	1996.12	0.0	1996.15	2.78	16492.12	3493.76
	4.000	2420.00	1972.00	21000.00	1998.68	0.0	1998.71	2.82	20470.16	4432.11
	4.000	2420.00	1972.00	25400.00	2000.93	0.0	2000.95	2.83	24258.28	5345.87
	4.000	2420.00	1972.00	29800.00	2002.89	0.0	2002.92	2.85	27738.81	6207.30
	4.000	2420.00	1972.00	34200.00	2004.70	0.0	2004.73	2.88	31066.80	7037.00
	4.000	2420.00	1972.00	45200.00	2008.58	0.0	2008.61	2.98	38638.37	8961.04
	4.000	2420.00	1972.00	56200.00	2011.84	0.0	2011.87	3.11	45413.81	10756.67
SECTION @ ≈1100 FT DS FROM DAM	3.000	2440.00	1974.00	500.00	1980.14	0.0	1980.31	3.38	148.08	84.20
	3.000	2440.00	1974.00	1000.00	1982.58	0.0	1982.75	3.69	613.81	143.73
	3.000	2440.00	1974.00	3200.00	1985.75	0.0	1985.88	4.28	2078.31	674.33
	3.000	2440.00	1974.00	5500.00	1988.36	0.0	1988.46	4.24	3548.99	1316.70
	3.000	2440.00	1974.00	7700.00	1990.16	0.0	1990.26	4.44	4690.34	1861.85
	3.000	2440.00	1974.00	10000.00	1992.01	0.0	1992.10	4.48	5980.65	2477.17
	3.000	2440.00	1974.00	12200.00	1993.69	0.0	1993.78	4.48	7256.95	3081.61
	3.000	2440.00	1974.00	16600.00	1996.60	0.0	1996.68	4.53	9686.04	4226.93
	3.000	2440.00	1974.00	21000.00	1999.11	0.0	1999.19	4.60	12011.54	5341.83
	3.000	2440.00	1974.00	25400.00	2001.31	0.0	2001.39	4.63	14231.50	6423.87
	3.000	2440.00	1974.00	29800.00	2003.24	0.0	2003.33	4.66	16319.82	7441.26
	3.000	2440.00	1974.00	34200.00	2005.03	0.0	2005.11	4.70	18362.77	8421.38
	3.000	2440.00	1974.00	45200.00	2008.88	0.0	2008.97	4.86	23155.52	10691.71
	3.000	2440.00	1974.00	56200.00	2012.12	0.0	2012.21	5.04	27586.12	12801.20
SECTION @ DS TOE OF DAM	2.000	1100.00	1975.00	500.00	1980.90	0.0	1980.92	1.21	411.98	91.27
	2.000	1100.00	1975.00	1000.00	1983.25	0.0	1983.28	1.41	712.83	160.48
	2.000	1100.00	1975.00	3200.00	1986.41	0.0	1986.48	2.30	2113.72	727.25
	2.000	1100.00	1975.00	5500.00	1988.87	0.0	1988.94	2.53	3473.75	1405.37
	2.000	1100.00	1975.00	7700.00	1990.64	0.0	1990.72	2.76	4462.41	1977.42
	2.000	1100.00	1975.00	10000.00	1992.43	0.0	1992.52	2.91	5482.66	2621.91
	2.000	1100.00	1975.00	12200.00	1994.07	0.0	1994.16	3.01	6424.59	3254.36
	2.000	1100.00	1975.00	16600.00	1996.92	0.0	1997.02	3.22	8113.14	4451.67
	2.000	1100.00	1975.00	21000.00	1999.40	0.0	1999.51	3.44	9661.25	5615.48
	2.000	1100.00	1975.00	25400.00	2001.58	0.0	2001.70	3.63	11092.32	6743.61
	2.000	1100.00	1975.00	29800.00	2003.49	0.0	2003.62	3.83	12409.32	7804.00
	2.000	1100.00	1975.00	34200.00	2005.26	0.0	2005.40	4.00	13675.26	8825.90
	2.000	1100.00	1975.00	45200.00	2009.09	0.0	2009.26	4.42	16575.39	11193.37
	2.000	1100.00	1975.00	56200.00	2012.31	0.0	2012.51	4.80	19187.66	13391.77

SUBJECT DAM SAFETY INSPECTION
LAUREL HILL CREEK DAM
BY WJV DATE 9-3-79 PROJ. NO. 78-617-235
CHKD. BY DAB DATE 9-4-79 SHEET NO. 4 OF K

OVERTOPPING

DAM SAFETY INSPECTION
LAUREL HILL CREEK DAM ****** OVERTOPPING ANALYSIS ******
15-MINUTE TIME STEP AND 48-HOUR STORM DURATION

JOB SPECIFICATION

NO	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
288	0	15	0	0	0	0	0	0	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 5 LRTIO= 1
RTIOS= .30 .40 .50 .60 1.00

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

INFLOW INTO LAUREL HILL CREEK DAM RESERVOIR

ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	26.20	0.00	26.20	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	24.00	92.00	110.00	120.00	130.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .831

INITIAL AND CONSTANT RAINFALL LOSSES AS PER COE

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA
TP= 2.37 CP= .40 NTA= 0

BASE FLOW PARAMETERS AS PER COE

RECESSION DATA
STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 9.82 AND R=17.80 INTERVALS

UNIT HYDROGRAPH100 END-OF-PERIOD ORDINATES, LAG= 2.37 HOURS, CP= .40 VOL= 1.00

85.	320.	659.	1062.	1511.	1963.	2352.	2649.	2843.	2896.
2801.	2668.	2503.	2366.	2237.	2115.	1999.	1890.	1787.	1689.
1597.	1510.	1427.	1349.	1275.	1206.	1140.	1078.	1019.	963.
910.	861.	814.	769.	727.	687.	650.	614.	581.	549.
519.	491.	464.	438.	415.	392.	370.	350.	331.	313.
296.	280.	264.	250.	236.	223.	211.	200.	189.	178.
169.	159.	151.	143.	135.	127.	120.	114.	108.	102.
96.	91.	86.	81.	77.	73.	69.	65.	61.	58.
55.	52.	49.	46.	44.	41.	39.	37.	35.	33.
31.	30.	28.	26.	25.	24.	22.	21.	20.	19.

GAI CONSULTANTS, INC
Engineers • Geologists • Planners
Environmental Specialists

SUBJECT DAM SAFETY INSPECTION
LAUREL HILL CREEK DAM
BY WJV DATE 9-3-79 PROJ. NO. 78-617-235
CHKD. BY DLR DATE 9-4-79 SHEET NO. T OF K

Engineers • Geologists • Planners
Environmental Specialists

GAI CONSULTANTS, INC

		END-OF-PERIOD FLOW									
MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	25.94	23.50	2.44	1584380.
										(659.)(597.)(62.)(44864.65)			

RESERVOIR INFLOW HYDROGRAPHS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME	
CFS	41454.	33640.	15303.	5501.	1584338.	
CMS	1174.	953.	433.	156.	44863.	
INCHES		11.94	21.73	23.44	23.44	PMF
MM		303.38	552.01	595.33	595.33	
AC-FT		16681.	30352.	32734.	32734.	
THOUS CU M		20576.	37439.	40377.	40377.	

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME	
CFS	12436.	10092.	4591.	1650.	475302.	
CMS	352.	286.	130.	47.	13459.	
INCHES		3.58	6.52	7.03	7.03	0.3 PMF
MM		91.01	165.60	178.60	178.60	
AC-FT		5004.	9106.	9820.	9820.	
THOUS CU M		6173.	11232.	12113.	12113.	

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME	
CFS	16582.	13456.	6121.	2200.	633735.	
CMS	470.	381.	173.	62.	17945.	
INCHES		4.78	8.69	9.38	9.38	0.4 PMF
MM		121.35	220.81	238.13	238.13	
AC-FT		6672.	12141.	13094.	13094.	
THOUS CU M		8230.	14976.	16151.	16151.	

HYDROGRAPH ROUTING

ROUTE INFLOW THROUGH RESERVOIR

ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
101	1	0	0	0	0	1	0	0

ROUTING DATA

OUTSK	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	250.	-1

STAGE	1982.00	1983.00	1984.00	1985.00	1986.00	1988.00	1990.00	1992.00	1994.00	
	1995.00	1996.90	1999.40	2001.60	2003.50	2005.30	2009.10			
FLOW	0.00	410.00	1070.00	2230.00	2920.00	4670.00	6920.00	9490.00	12070.00	
	13610.00	16600.00	21000.00	25400.00	29800.00	34200.00	45200.00			
CAPACITY=	0.	250.	340.	517.	780.	944.	1129.	1336.	1564.	1814.
	2085.	2113.	2378.	2692.	3028.	3385.	3764.	4164.	6544.	9590.
ELEVATIONS=	1974.	1982.	1984.	1986.	1988.	1989.	1990.	1991.	1992.	1993.
	1994.	1994.	1995.	1996.	1997.	1998.	1999.	2000.	2005.	2010.

SUBJECT DAM SAFETY INSPECTION
LAUREL HILL CREEK DAM
BY WJV DATE 9-3-79 PROJ. NO. 78-617-235
CHKD. BY DLB DATE 9-4-79 SHEET NO. 1 OF K

Engineers • Geologists • Planners
Environmental Specialists

CNEL	SPWID	COOW	EXPW	ELEVL	COOL	CAREA	EXPL
1982.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COOD	EXPD	DAM#ID
1994.1	0.0	0.0	0.

RESERVOIR OUTFLOW HYDROGRAPHS

OVERTOPPING OCCURS @ ~ 0.36 PMF

PEAK OUTFLOW IS 32494. AT TIME 44.25 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	32494.	29214.	15198.	5500.	1584040.
CMS	920.	827.	430.	156.	44855.
INCHES		10.37	21.58	23.43	23.43
MM		263.46	548.22	595.22	595.22
AC-FT		14486.	30144.	32728.	32728.
THOUS CU M		17868.	37182.	40370.	40370.

PMF

PEAK OUTFLOW IS 10238. AT TIME 44.00 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	10238.	9189.	4582.	1650.	475213.
CMS	290.	260.	130.	47.	13457.
INCHES		3.26	6.51	7.03	7.03
MM		82.87	165.28	178.57	178.57
AC-FT		4556.	9088.	9818.	9818.
THOUS CU M		5620.	11210.	12111.	12111.

0.3 PMF

PEAK OUTFLOW IS 13389. AT TIME 44.25 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	13389.	12061.	6108.	2200.	633619.
CMS	379.	342.	173.	62.	17942.
INCHES		4.28	8.67	9.37	9.37
MM		108.77	220.34	238.09	238.09
AC-FT		5981.	12115.	13091.	13091.
THOUS CU M		7377.	14944.	16148.	16148.

0.4 PMF

SUBJECT DAM SAFETY INSPECTION
LAUREL HILL CREEK DAM

BY WJV DATE 9-3-79 PROJ. NO. 78-617-235

CHKD. BY DLB DATE 9-4-79 SHEET NO. K OF K

GAI CONSULTANTS, INC.
Engineers • Geologists • Planners
Environmental Specialists

SUMMARY OF DAM SAFETY ANALYSIS

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1982.00	1982.00	1994.10
STORAGE	250.	250.	2113.
OUTFLOW	0.	0.	12200.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.30	1992.58	0.00	1709.	10238.	0.00	44.00	0.00
.40	1994.86	.76	2536.	13369.	3.00	44.25	0.00
.50	1996.86	2.76	2980.	16532.	5.75	44.25	0.00
.60	1998.66	4.56	3637.	19705.	7.75	44.25	0.00
1.00	2004.60	10.50	6355.	32494.	12.25	44.25	0.00

LIST OF REFERENCES

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2. "Unit Hydrograph Concepts and Calculations," by Corps of Engineers, Baltimore District (L-519).

3. "Seasonal Variation of Probable Maximum Precipitation East of the 105th Meridian for Areas from 10 to 1,000 Square Miles and Duration of 6, 12, 24, and 48 Hours," Hydrometeorological Report No. 33, prepared by J. T. Riedel, J. F. Appleby and R. W. Schloemer Hydrologic Service Division Hydrometeorological Section, U. S. Department of the Army, Corps of Engineers, Washington, D. C., April 1956.

4. Design of Small Dams, U. S. Department of the Interior, Bureau of Reclamation, Washington, D. C., 1973.

5. Handbook of Hydraulic, H. W. King and E. F. Brater, McGraw-Hill, Inc., New York, 1963.

6. Standard Handbook for Civil Engineers, F. S. Merritt McGraw-Hill, Inc., New York, 1968.

7. Open-Channel Hydraulics, V. T. Chow, McGraw-Hill, Inc., New York, 1959.

8. Weir Experiments, Coefficients, and Formulas, R. E. Horton, Water Supply and Irrigation Paper No. 200, Department of the Interior, United States Geological Survey, Washington, D. C., 1907.

9. "Probable Maximum Precipitation Susquehanna River Drainage Above Harrisburg, Pennsylvania," Hydrometeorological Report 40, prepared by H. V. Goodyear and J. T. Riedel, Hydrometeorological Branch Office of Hydrology, U. S. Weather Bureau, U. S. Department of Commerce, Washington, D. C., May 1965.

10. Flood Hydrograph Package (HEC-1) Dam Safety Version, Hydrologic Engineering Center, U. S. Army Corps of Engineers, Davis, California, July 1978.

11. "Simulation of Flow Through Broad Crest Navigation Dams with Radial Gates," R. W. Schmitt, U. S. Army Corps of Engineers, Pittsburgh District.

12. "Hydraulics of Bridge Waterways," BPR, 1970, Discharge Coefficient Based on Criteria for Embankment Shaped Weirs, Figure 24, page 46.

13. Applied Hydraulics in Engineering, Morris, Henry M. and Wiggert, James N., Virginia Polytechnic Institute and State University, 2nd Edition, The Ronald Press Company, New York, 1972.

14. Standard Mathematical Tables, 21st Edition, The Chemical Rubber Company, 1973, page 15.

15. Engineering Field Manual, U. S. Department of Agriculture, Soil Conservation Service, 2nd Edition, Washington, D. C. 1969.

APPENDIX D

PHOTOGRAPHS

PHOTOGRAPH 1 Overview photograph of Laurel Hill Creek Dam taken from the right abutment. Note the vegetation within site reservoir area.

PHOTOGRAPH 2 Close-up view of the spillway as seen from the left sidewall. The pumphouse is visible on the extreme left portion of the view.

PHOTOGRAPH 3 View of the upstream face of Laurel Hill Creek Dam.

PHOTOGRAPH 4 View of cattails and other hydrophylic vegetation at the downstream toe of the dam.

1

2

3

4

PHOTOGRAPH 5 View of some areas void of vegetation on the downstream dam face.

PHOTOGRAPH 6 View of a small slide on the left abutment just upstream of the crest.

PHOTOGRAPH 7 View from the dam crest of the area downstream of the dam and a pond used to impound sediment dredged from the reservoir.

PHOTOGRAPH 8 View of the dam at Laurel Hill State Park located approximately 5.5 miles downstream of Laurel Hill Creek Dam.

5

6

APPENDIX E

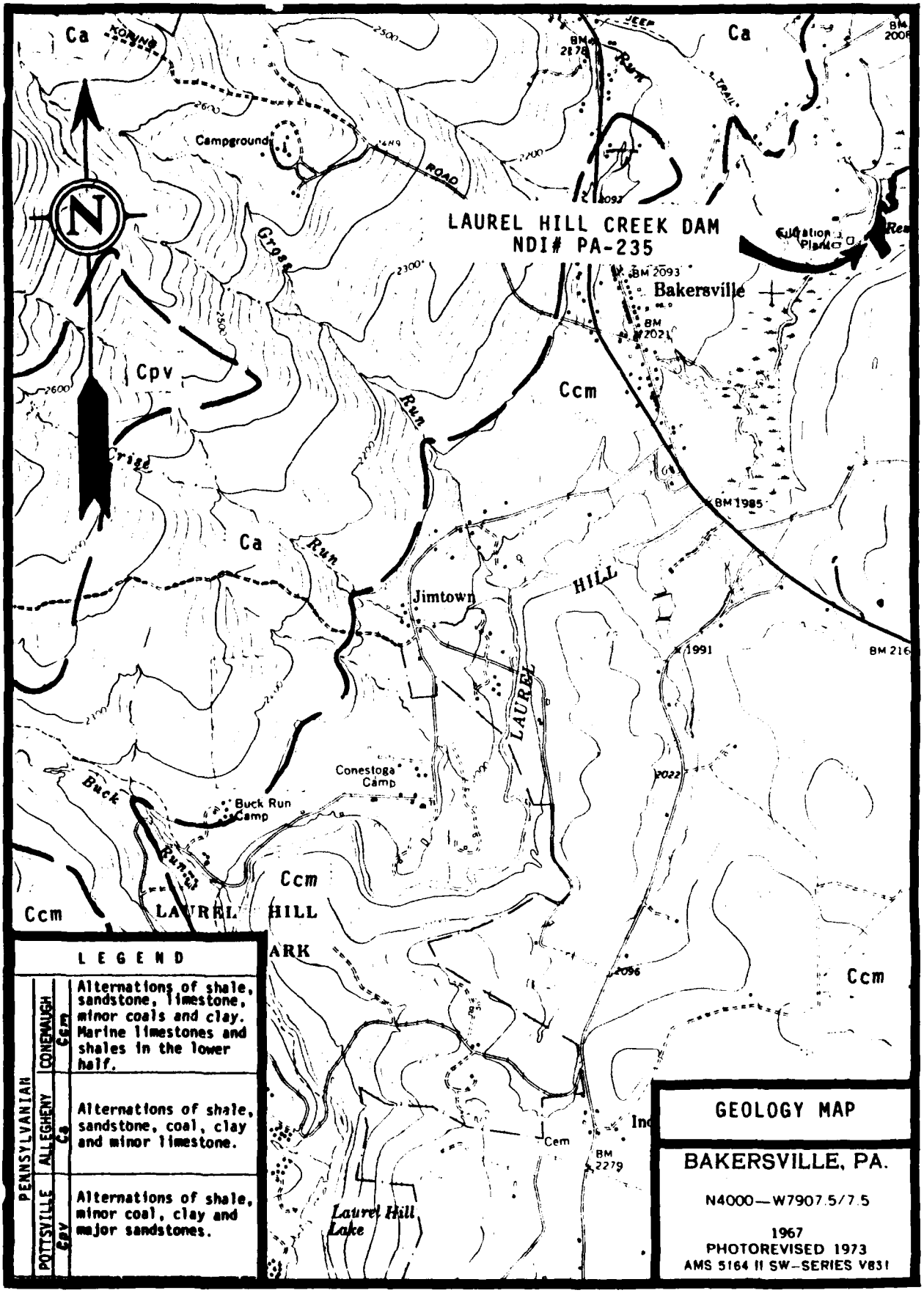
GEOLOGY

Geology

Laurel Hill Creek Dam is located approximately 7.5 miles west of Somerset in the Allegheny Mountain Section of the Appalachian Plateaus Province. The Allegheny Mountain Section is characterized by gently folded sedimentary rock strata of Pennsylvanian age or older. Major structural axes strike from southwest to northeast of flanking strata dipping northwest and southeast.

Structurally, the dam and reservoir lie approximately midway of the Laurel Hill anticline to the west and the New Lexington (Johnstown) syncline to the east. The bedrock flanking the east side of Laurel Hill consist of Mississippian age strata in the higher elevations and Pennsylvanian age strata in the vicinity of the dam. Near the dam, the sedimentary rock strata dip to the southeast at approximately 125 feet per mile or about two degrees.

The strata underlying the alluvial and residual soils of the valley at the dam site are members of the lower half of the Conemaugh Group of Pennsylvanian age. The lower portion of the Conemaugh Group generally consists of alternating beds of shale, sandstone, limestone, minor coals, and clay. Thin beds of marine limestones and shales are present throughout.


LAUREL HILL CREEK DAM
NDI# PA-235
Bakersville
Jimtown
Campground
Buck Run Camp
Conestoga Camp
Laurel Hill Lake
Ca
Cpv
Ccm
Cem
BM 2093
BM 2021
BM 1985
BM 1991
BM 2279
LEGEND
PENNSYLVANIAN
CONEMAUGH Ccm
Alternations of shale, sandstone, limestone, minor coals and clay. Marine limestones and shales in the lower half.
ALLEGHENY Ca
Alternations of shale, sandstone, coal, clay and minor limestone.
POTTSVILLE Cpv
Alternations of shale, minor coal, clay and major sandstones.
GEOLOGY MAP
BAKERSVILLE, PA.
N4000—W7907.5/7.5
1967
PHOTOREVISED 1973
AMS 5164 II SW-SERIES V831

APPENDIX F

FIGURES

LIST OF FIGURES

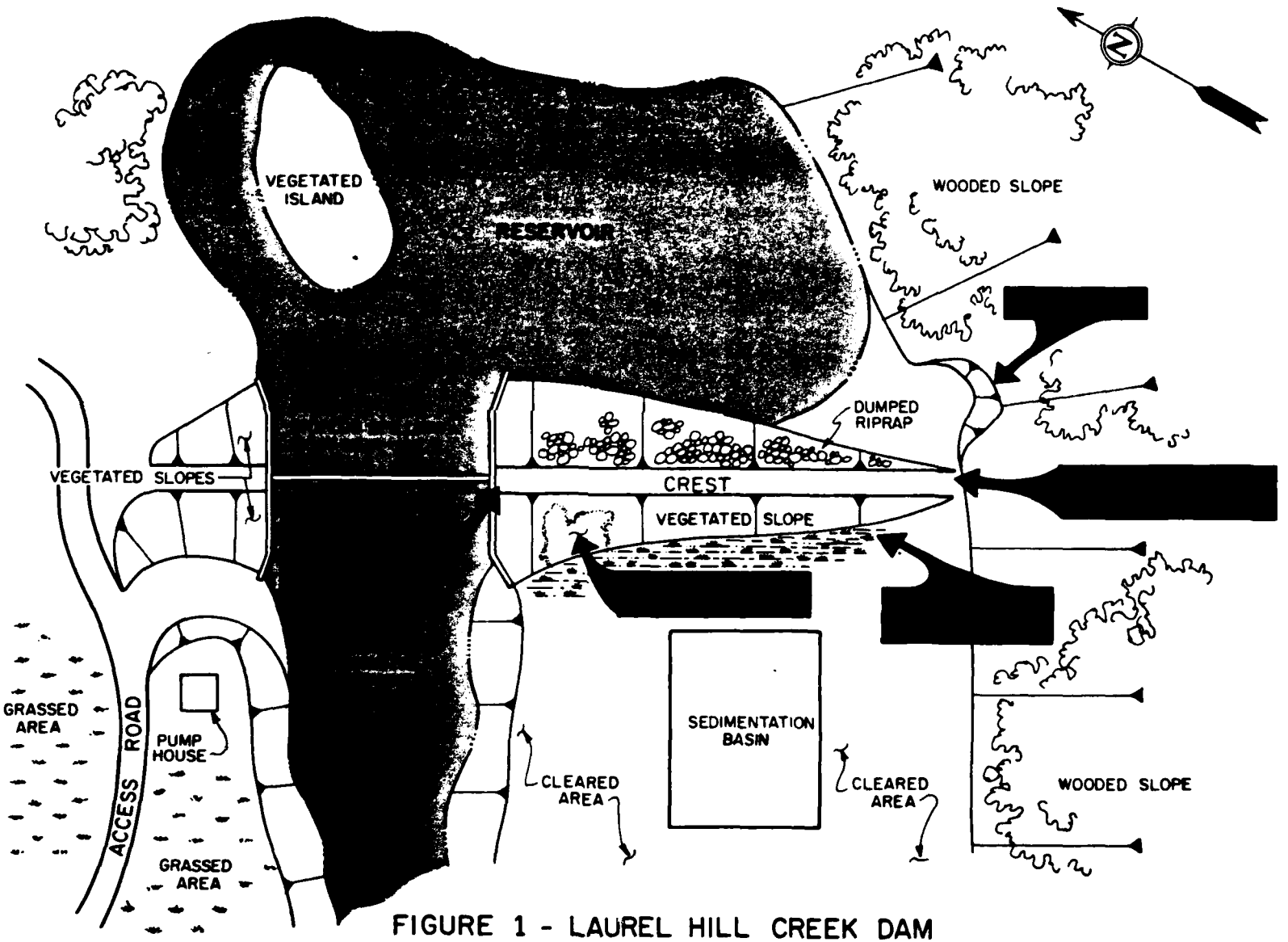
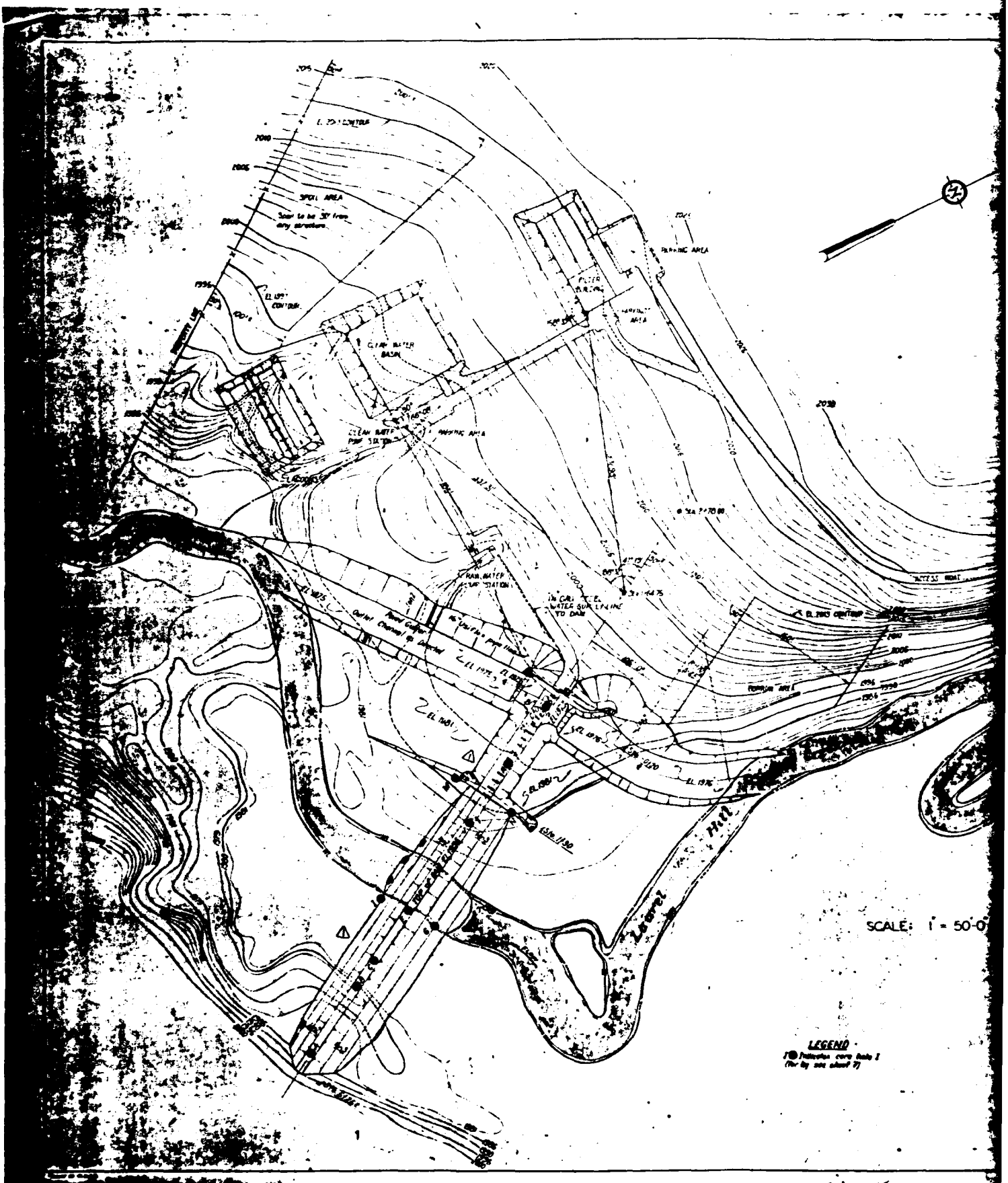


FIGURE 1 - LAUREL HILL CREEK DAM
GENERAL PLAN : FIELD INSPECTION NOTES


SCALE: 1" = 50'-0"
LEGEND

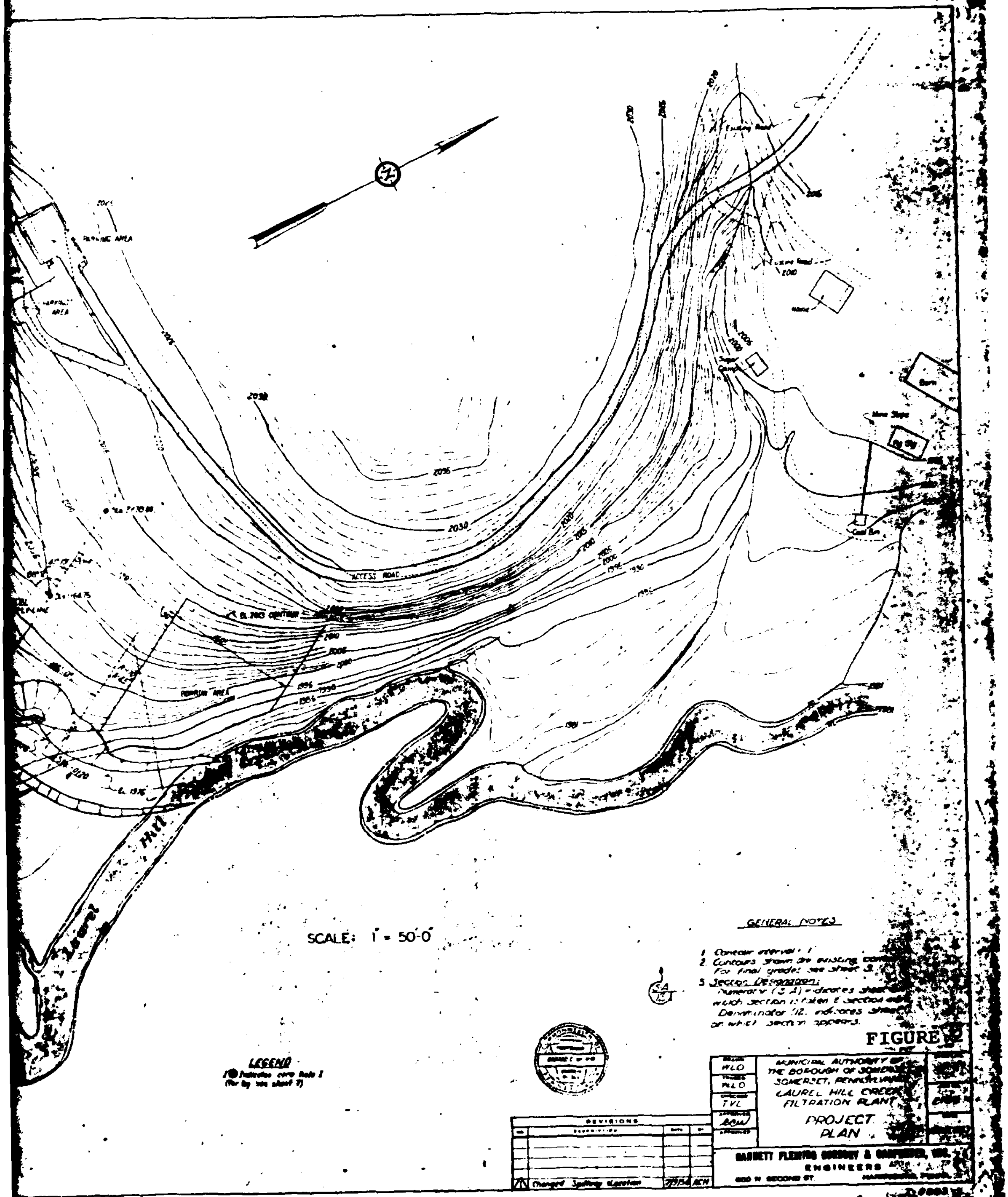
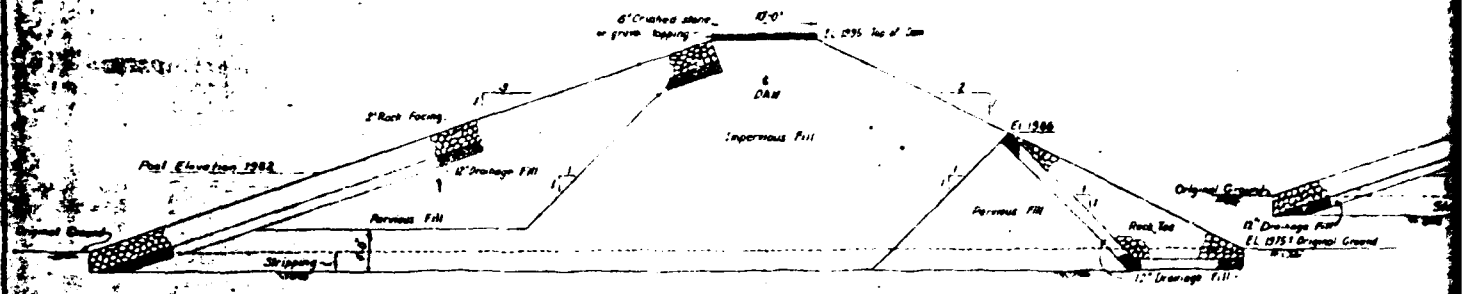

ACCESS ROAD
PARKING AREA
SCALE: 1" = 50'-0"
GENERAL NOTES
1. Contour interval: 1'
2. Contours shown are existing contours. For final grades see sheet 3.
3. Section Designation: Numerator (3 A) indicates sheet on which section is taken & section; Denominator (12) indicates sheet on which section appears.
LEGEND
MUNICIPAL AUTHORITY OF THE BOROUGH OF SOMERSET, SOMERSET, PENNSYLVANIA
LAUREL HILL CREEK FILTRATION PLANT
PROJECT PLAN
WLO
WLO
TVL
REVISIONS
Changed Spillway Location
ENGINEERS
Laurel Hill

FIGURE 2

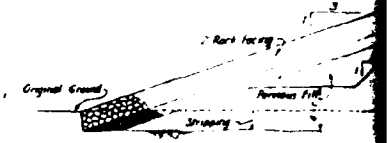


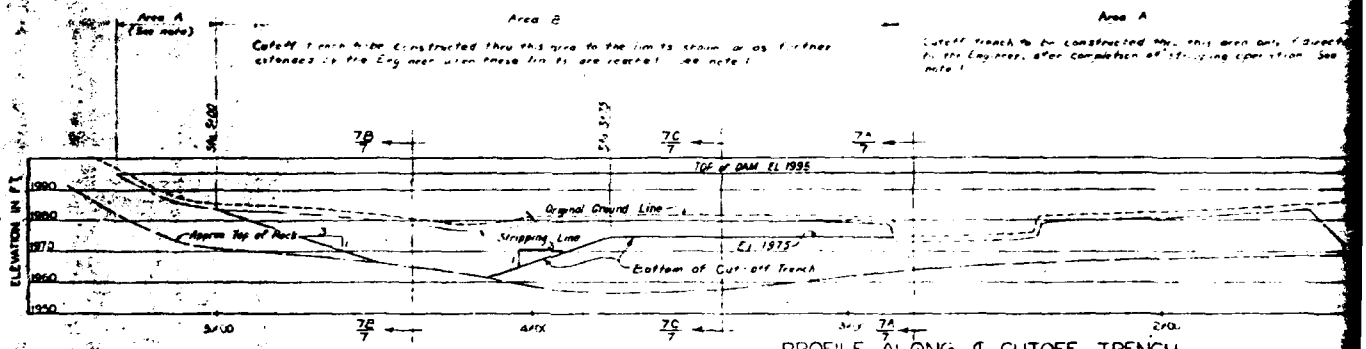
NOTES

1. The depth and extent of cut-off trench may be modified by the Engineer in field. All loose sand, gravel, or other pervious material, as determined by the Engineer, shall be removed from the cut-off trench ℄.
2. Any impervious material from excavation to be wasted shall be spread in 12" layers at upstream toe of dam to form an impervious blanket. The sequence and limit or extent of material dumping for blanket shall be as directed by Engineer.

SECTION 7A/7

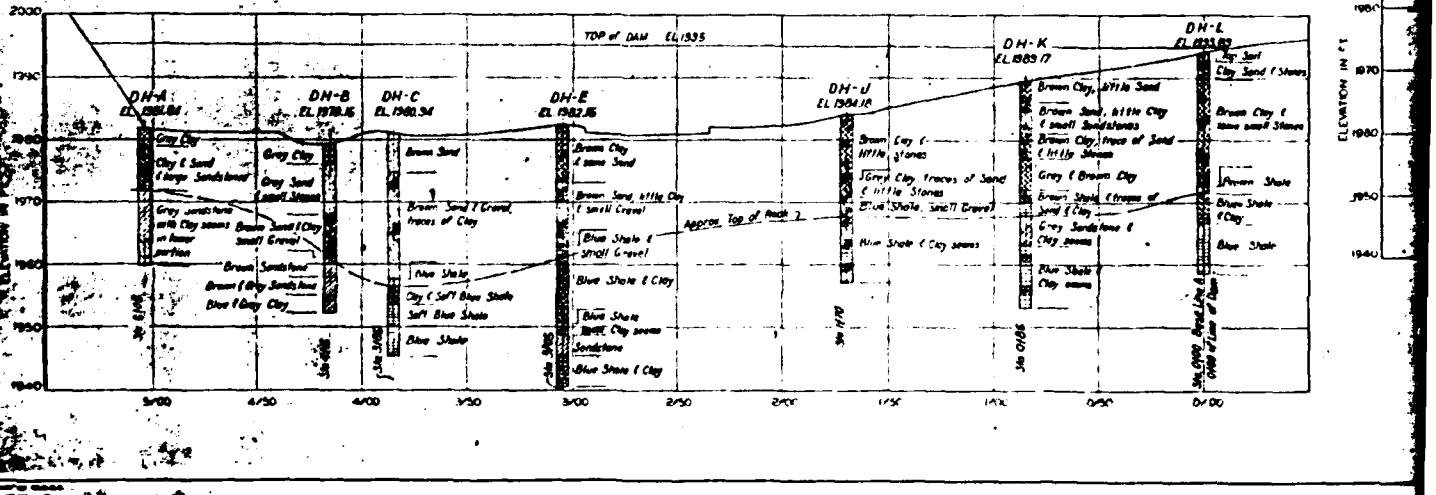
SCALE 1" = 20'-0"

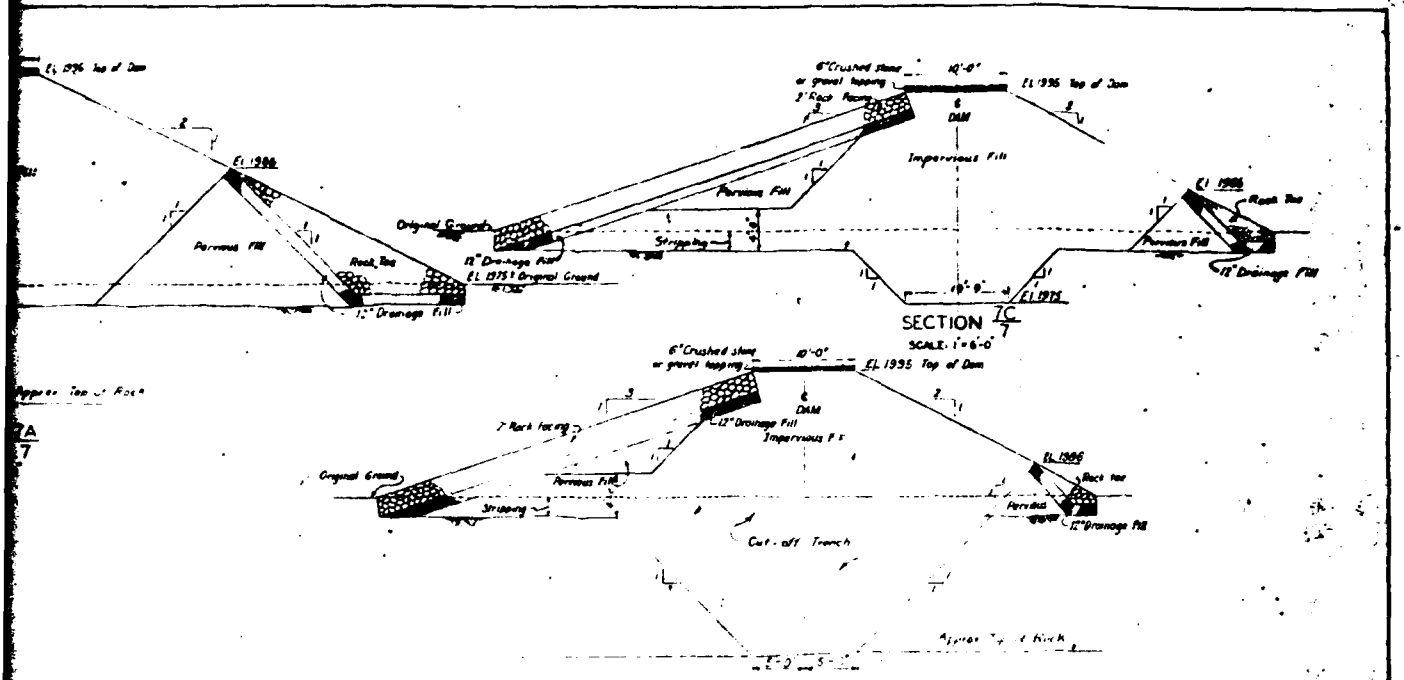


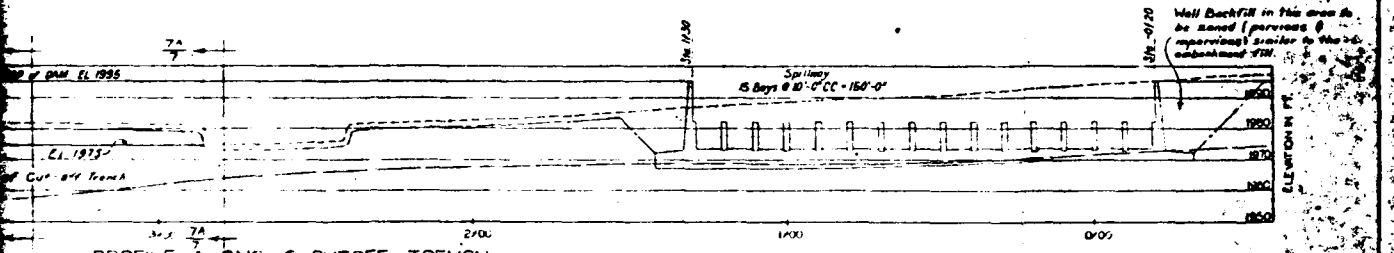


PROFILE ALONG ℄ CUTOFF TRENCH

SCALE 1"=20'-0"

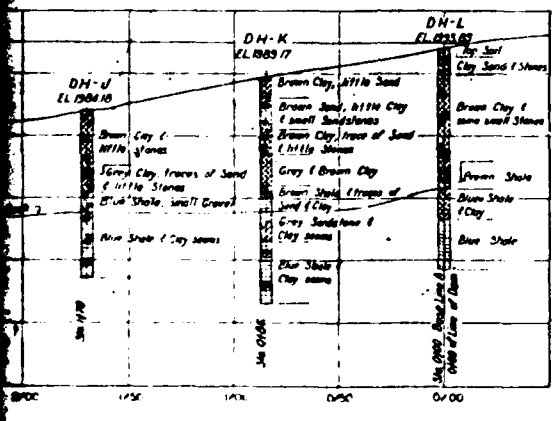






PROFILE ALONG ℄ CUTOFF TRENCH

SCALE 1"=20'-0"



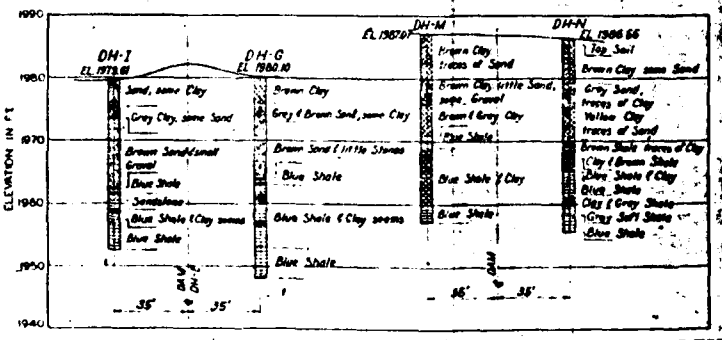


FIGURE 3

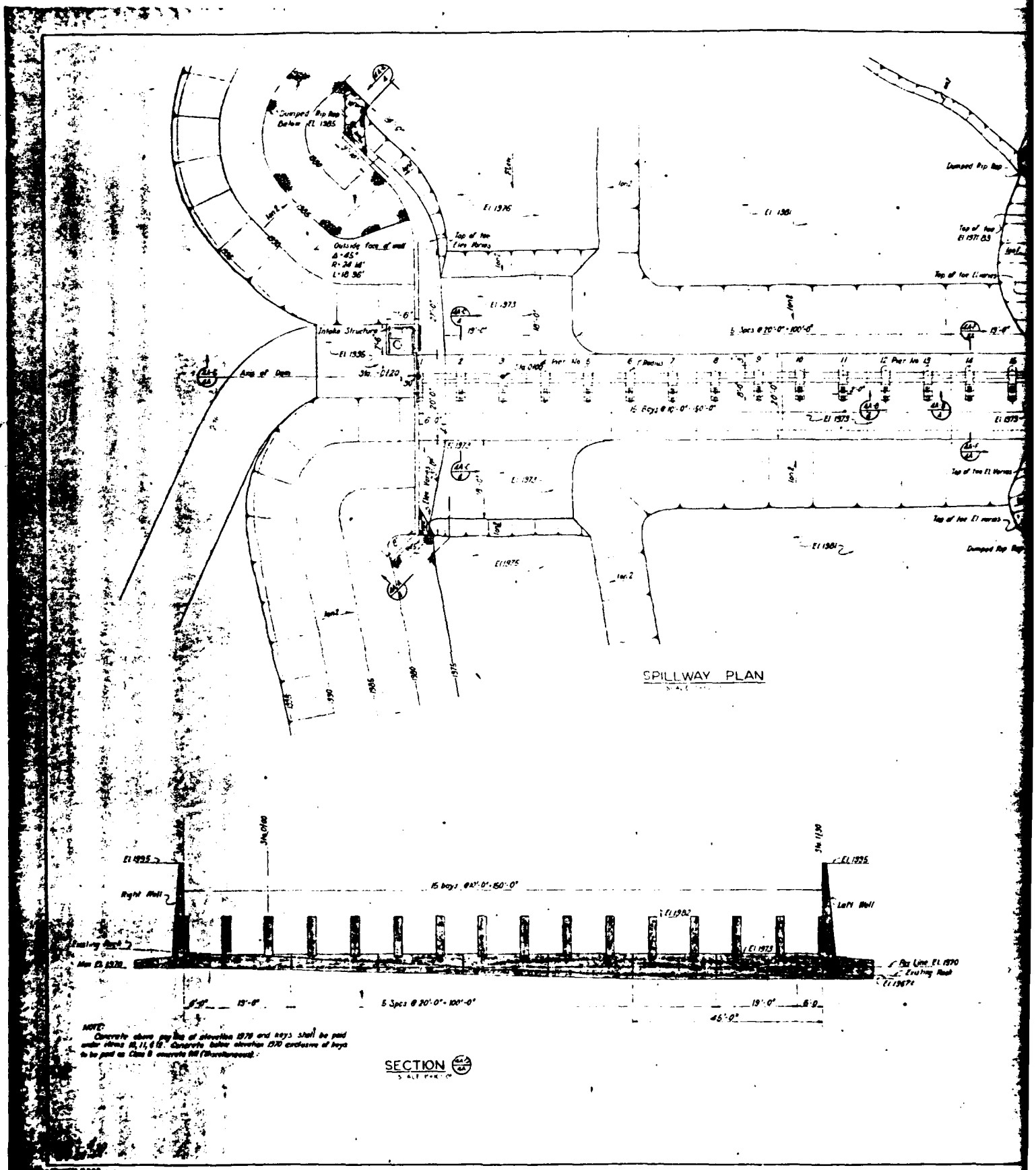
NOTE:
This sheet (7-A) replaces sheet 7 of original contract drawings

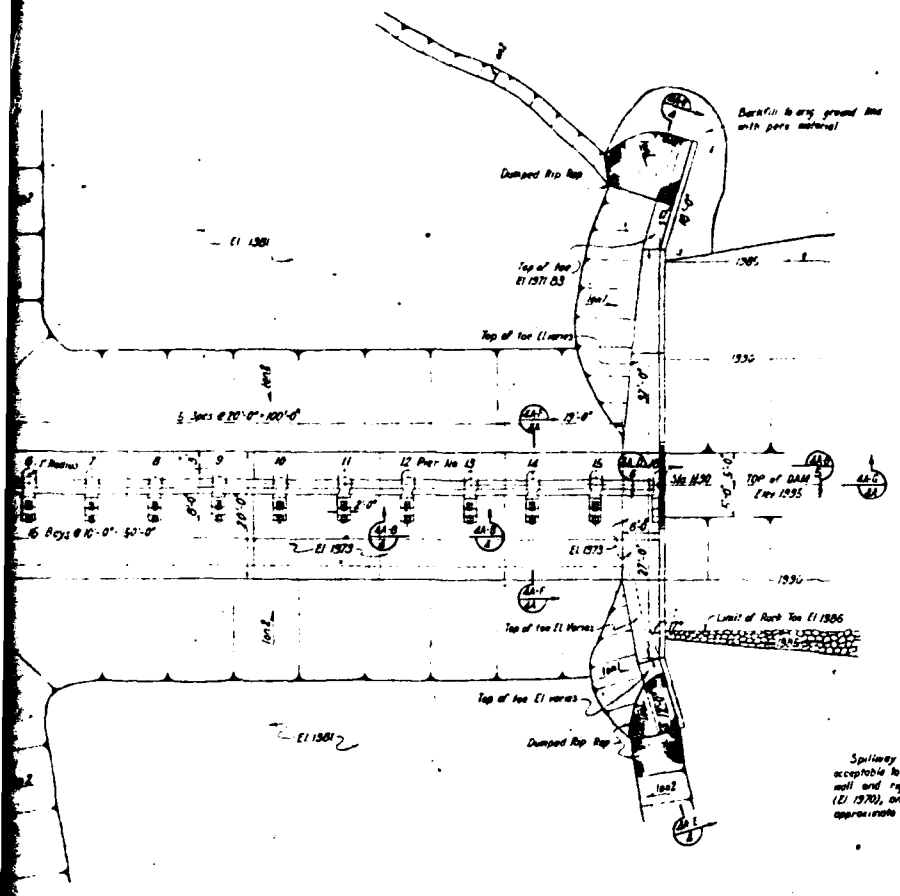
Section W.L.O.	MUNICIPAL AUTHORITY OF THE BOROUGH OF SOMERSET SOMERSET PENNSYLVANIA
Traced W.L.O.	LAUREL HILL CREEK FILTRATION PLANT
Checked C.R.	DAM EMBANKMENT SECTIONS, CUTOFF TRENCH DETAILS & LOG OF BORINGS
Computed A.E.H.	
Sheet No.	7-A
Job No.	2166
Date	JUNE, 1956

REVISIONS

No.	Description	Date	By

GARRETT FLEMING GORDON & CARPENTER, INC.
ENGINEERS
600 N. SECOND ST. HARRISBURG, PENNA.

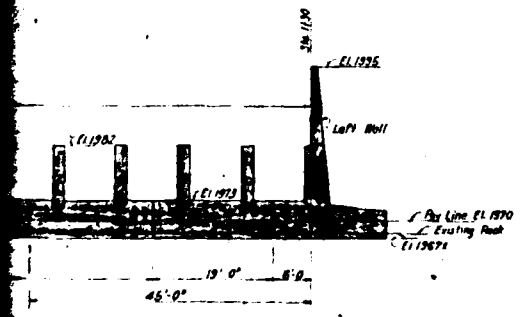

Dumped Rip Rap Below El 1985
Outside face of wall
Δ=45°
R=24.14'
L=18.96'
Intake Structure
El 1935
Axis of Dam
Sta 0+20
Sta 0+00
Inter No. 5
Pier No. 13
15 Bays @ 10'-0" = 150'-0"
5 Spcs @ 20'-0" = 100'-0"
El 1976
El 1981
El 1973
El 1971.83
Top of Ice Flex Horns
Dumped Rip Rap
SPILLWAY PLAN
Sta 0+00
Sta 1+50
El 1935
Right Wall
Left Wall
15 bays @ 10'-0" = 150'-0"
El 1982
El 1973
Top Line El 1970
Existing Rock
El 1967±
5 Spcs @ 20'-0" = 100'-0"
45'-0"
NOTE:
Concrete above pay line at elevation 1978 and keys shall be paid under Items 10, 11, & 12. Concrete below elevation 1970 exclusive of keys to be paid as Class B concrete fill (Unclassified).
SECTION

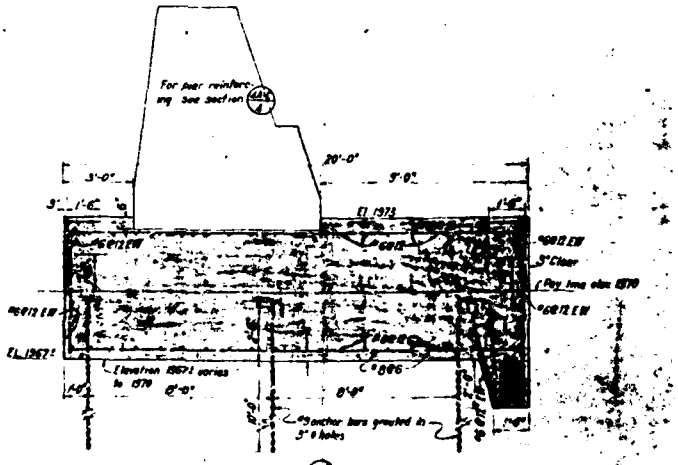


SPILLWAY PLAN

FOUNDATION NOTE

Spillway slabs and training walls are to be constructed upon a rock foundation acceptable to the Engineer in the field. It is anticipated that the right training wall and right portion of the spillway slab can be constructed on plan foundation (El 1970), and that the acceptable foundation surface will grade downward to approximate elevation 1967 at the left training wall and left portion of the slab.





SECTION

FIGURE 4

DESIGNED	WLG
TRACED	WLG
CHECKED	ACH
APPROVED	

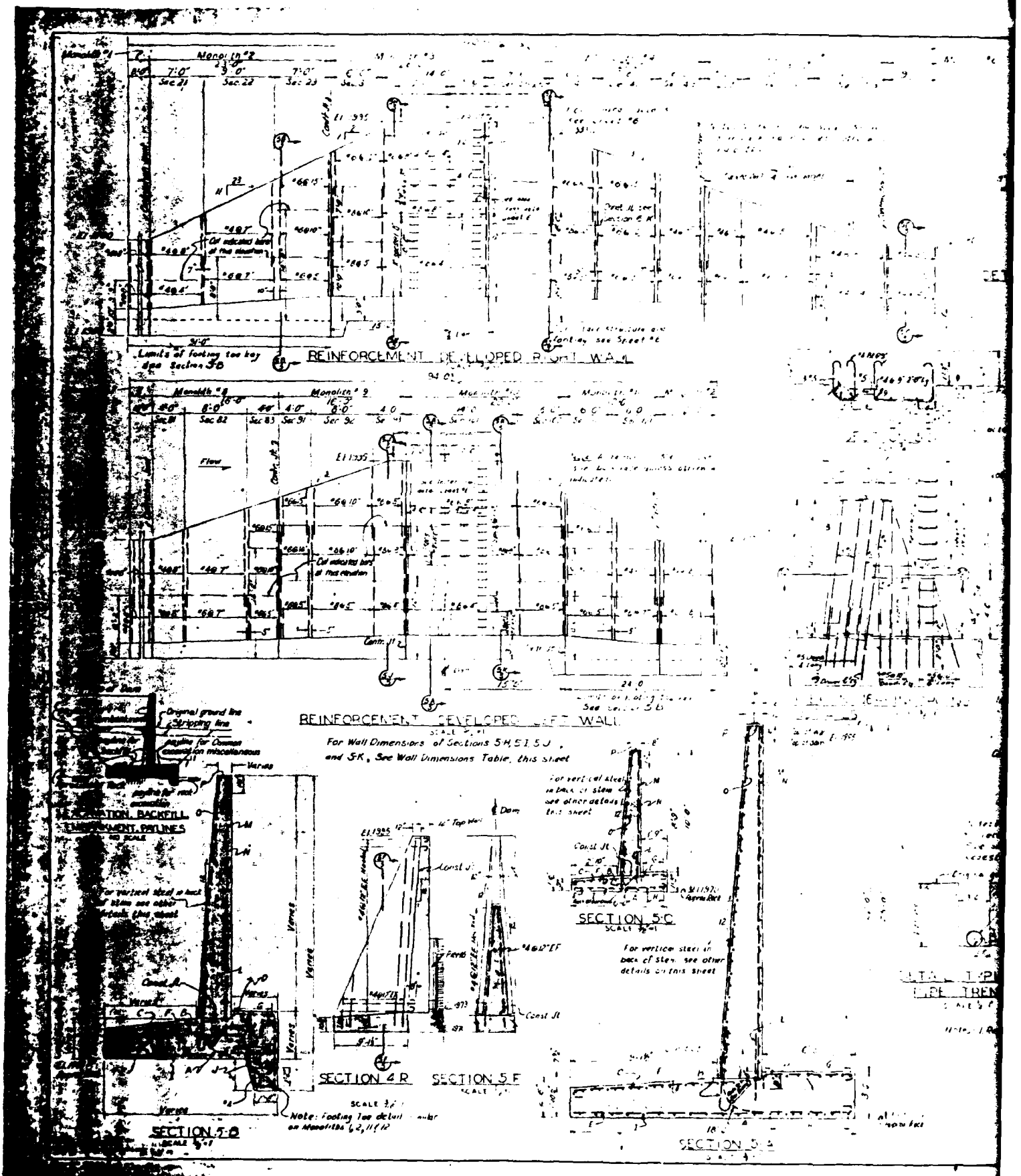
MUNICIPAL AUTHORITY OF THE BOROUGH OF SOMERSET
SOMERSET PENNSYLVANIA
LAUREL HILL CREEK FILTRATION PLANT
DAM SPILLWAY DETAILS II

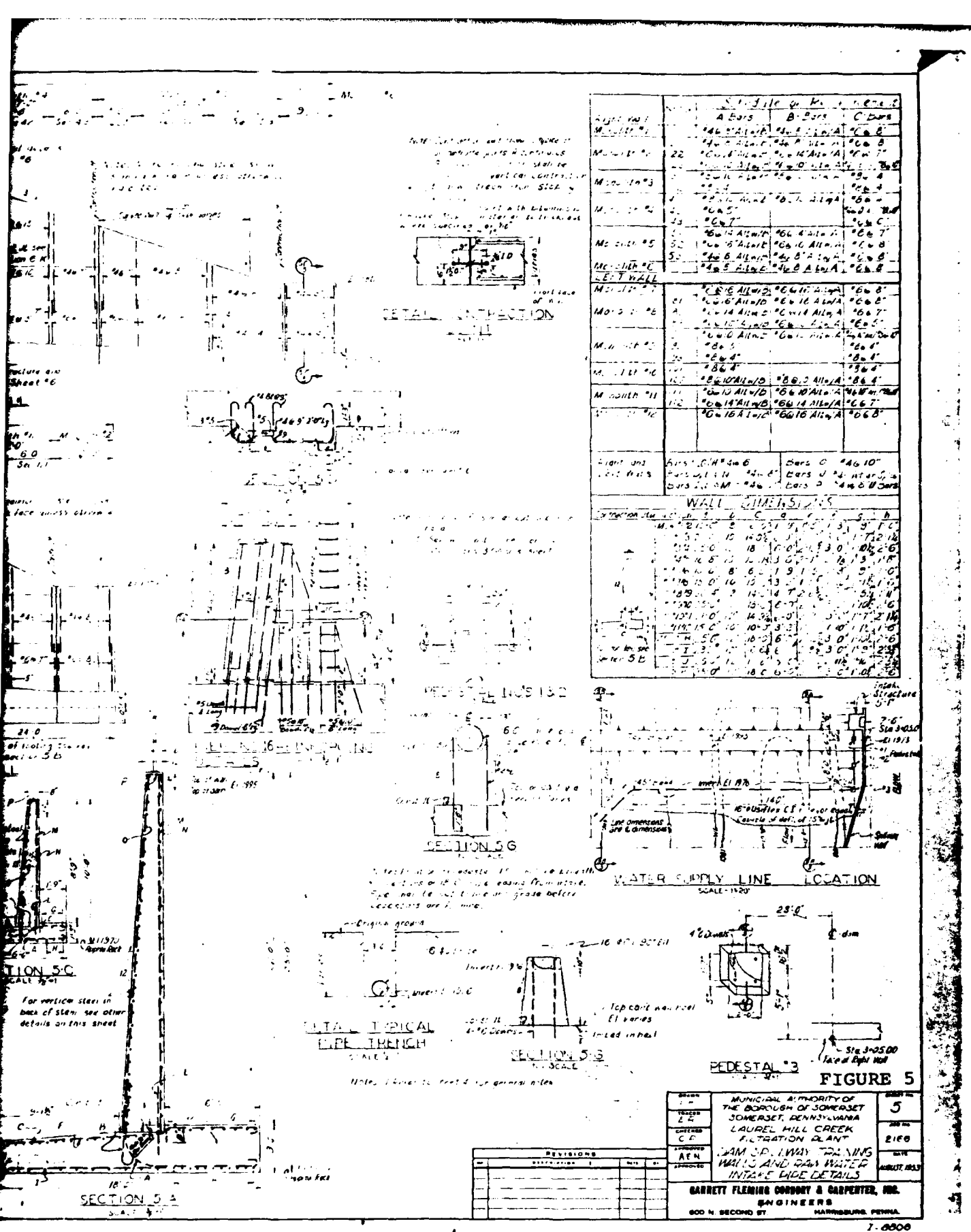
DRAWING NO. 4A
JOB NO. 2166
DATE JUNE 1964

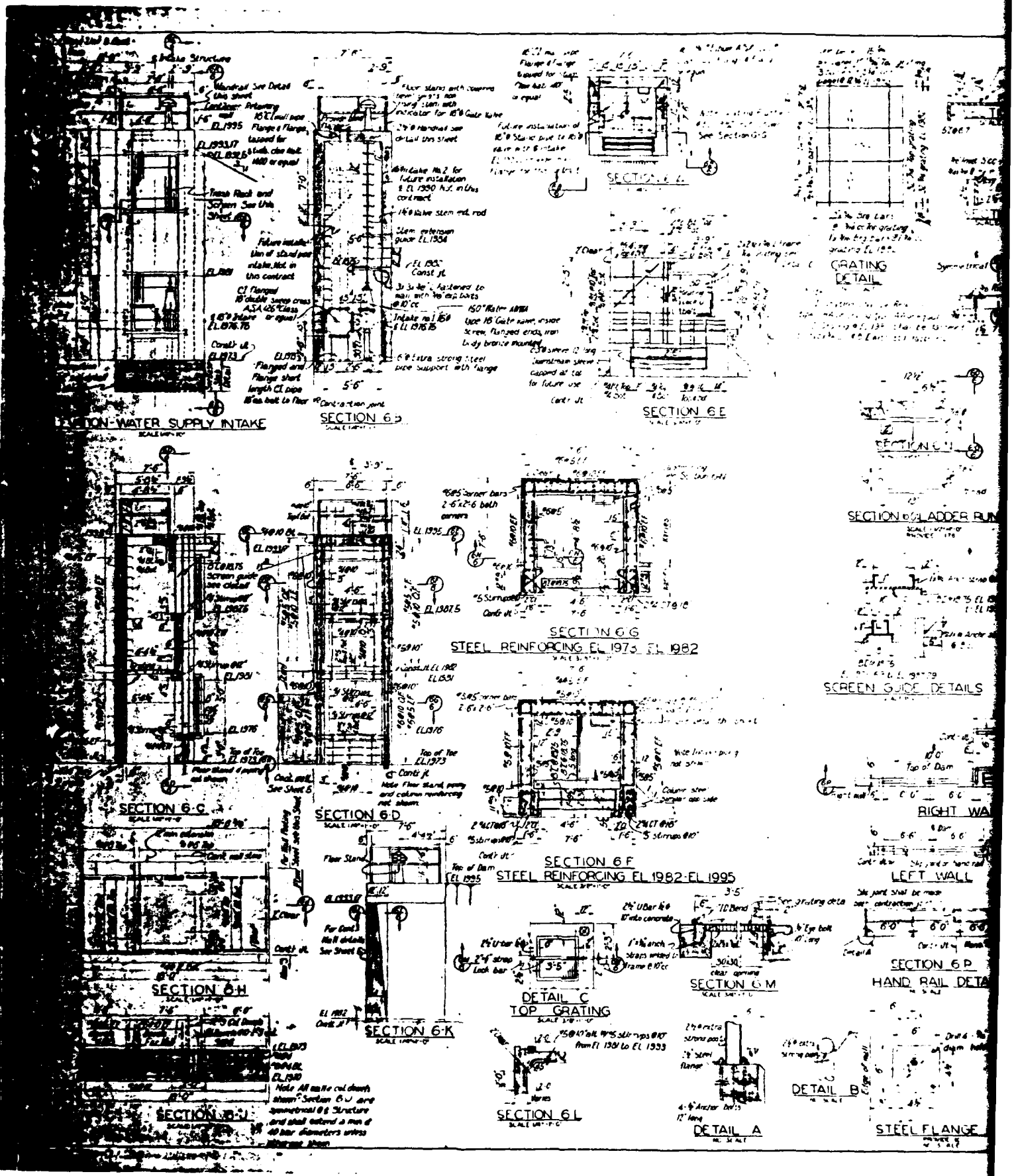
REVISIONS

NO.	DESCRIPTION	DATE	BY

GARRETT FLEMING GODSHALL & CARPENTER, INC.
ENGINEERS
600 N. SECOND ST. HARRISBURG, PENNA.


REINFORCEMENT DEVELOPED RIGHT WALL
REINFORCEMENT DEVELOPED LEFT WALL
For Wall Dimensions of Sections 5H, 5I, 5J, and 5K, See Wall Dimensions Table, this sheet
SECTION 5-D
SECTION 4-R
SECTION 5-E
SECTION 5-C
SECTION 5-A
EXCAVATION, BACKFILL & EMBANKMENT OUTLINES
Note: Footing Toe detail similar on Monoliths 1, 2, 11 & 12


WALL TIMES SIZES
SECTION 5 A
SECTION 5 B
SECTION 5 C
SECTION 5 G
DETAIL TYPICAL PIPE TRENCH
WATER SUPPLY LINE LOCATION
PEDESTAL #3
Sta 3+05.00 face of Right Wall
FIGURE 5
MUNICIPAL AUTHORITY OF THE BOROUGH OF SOMERSET SOMERSET, PENNSYLVANIA
LAUREL HILL CREEK FILTRATION PLANT
DAM SPILLWAY TRAINING WALLS AND RAW WATER INTAKE LAKE DETAILS
GARRETT FLEMING CONDORY & CARPENTER, INC.
ENGINEERS
600 N. SECOND ST HARRISBURG, PENNA.
AUGUST 1953
5
2168
1-6606


SECTION-WATER SUPPLY INTAKE
SECTION 6-B
SECTION 6-E
GRATING DETAIL
SECTION 6-L
SECTION 6-G
STEEL REINFORCING EL 1973 EL 1982
SCREEN GUIDE DETAILS
SECTION 6-C
SECTION 6-D
SECTION 6-F
STEEL REINFORCING EL 1982-EL 1995
SECTION 6-H
SECTION 6-K
DETAIL C
TOP GRATING
SECTION 6-M
SECTION 6-P
HAND RAIL DETA
LEFT WALL
RIGHT WA
SECTION 6-J
SECTION 6-L
DETAIL A
DETAIL B
STEEL FLANGE

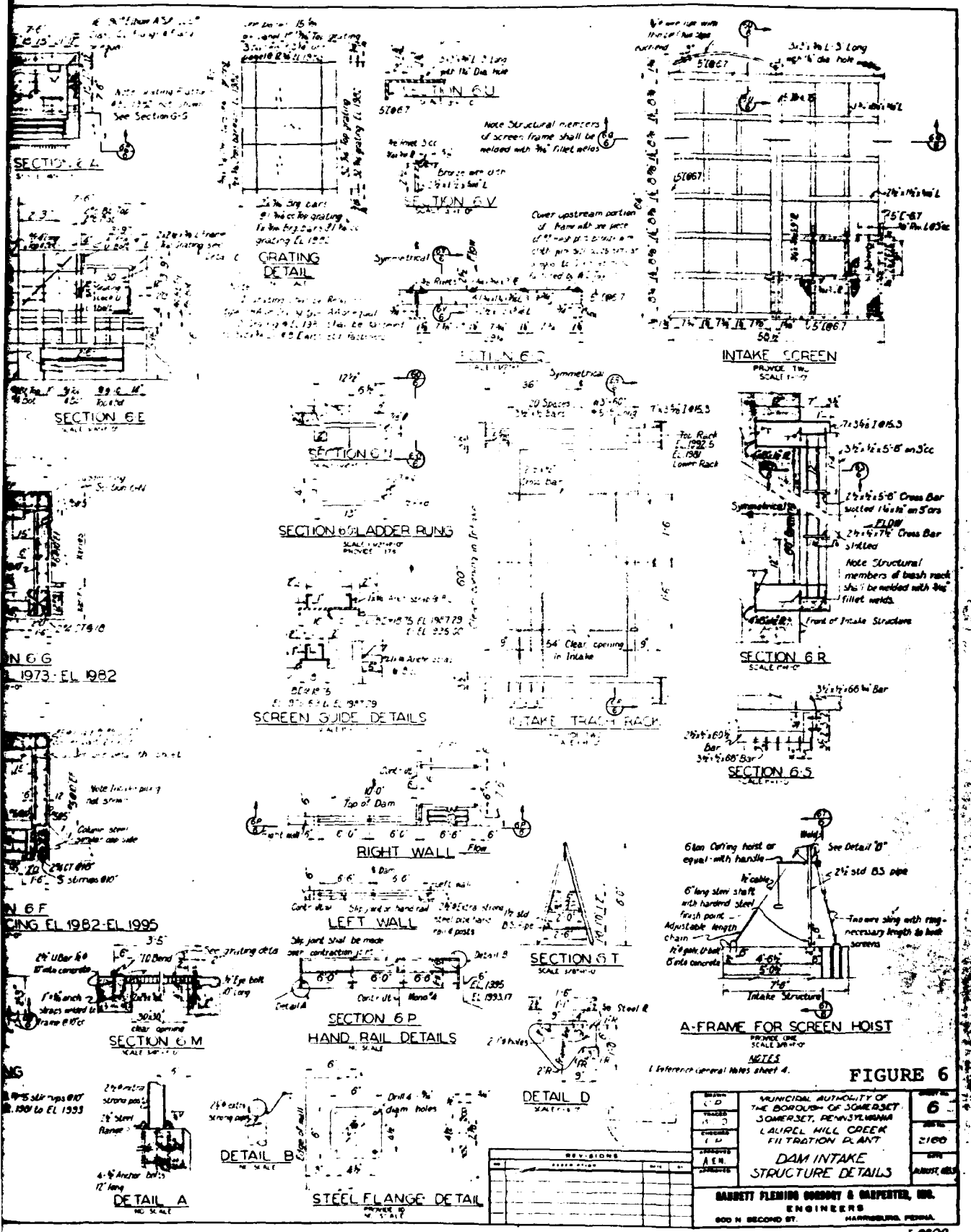


FIGURE 6

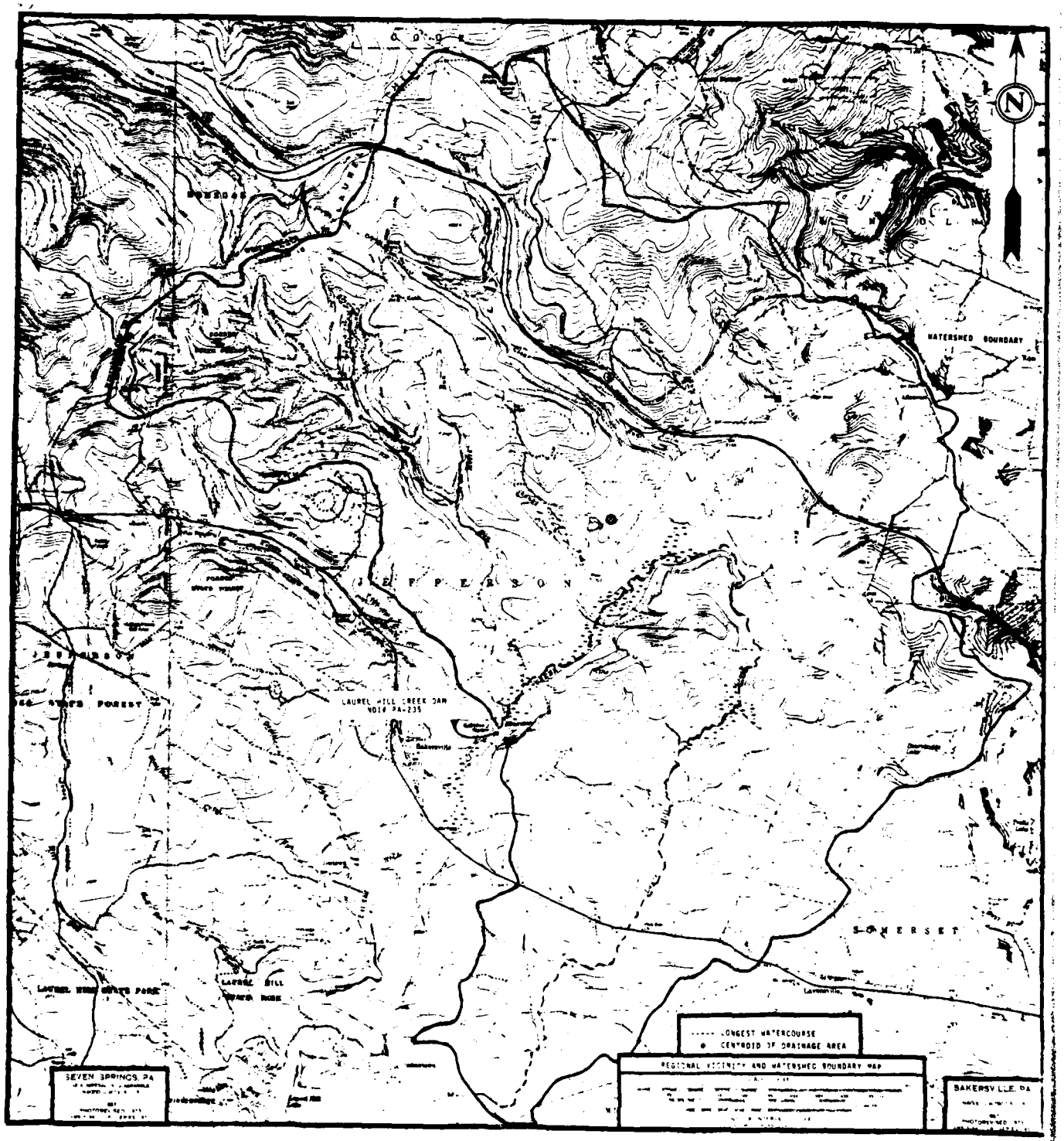
MUNICIPAL AUTHORITY OF THE BOROUGH OF SOMERSET, SOMERSET, PENNSYLVANIA
LAUREL HILL CREEK FILTRATION PLANT
DAM INTAKE STRUCTURE DETAILS
SHEET NO. 6
JOB NO. 2160
DATE AUGUST, 1973

BARRETT FLEMING DODDOFF & CARPENTER, INC.
ENGINEERS
600 N. SECOND ST. HARRISBURG, PENNA.

J. 6509

APPENDIX G

REGIONAL VICINITY AND WATERSHED BOUNDARY MAP


N
WATERSHED BOUNDARY
JEFFERSON
SOMERSET
LAUREL HILL CREEK DAM
NO. PA-235
LONGEST WATERCOURSE
CENTROID OF DRAINAGE AREA
REGIONAL VICINITY AND WATERSHED BOUNDARY MAP
SEVEN SPRINGS, PA
BAKERSVILLE, PA